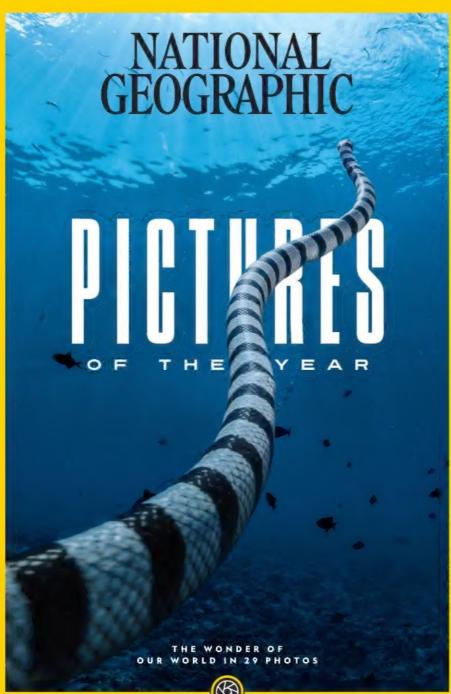
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WHAT DO THEY SEEK?

Explorers, adventurers, scientists. Men and women who always broadened the horizons, for all humankind to share. Rolex was at their side when they reached the deepest point in the oceans, the highest summits of the Earth, the deepest jungles and both poles. But now that we know, more than ever, that our world has its limits, why do they continue to venture out there, again and again? Certainly not for kudos, accolades, or an ephemeral record. What they truly seek is to understand more intimately how complex and delicate our planet is, to document its change and how together, we can affect it for the better. So as long as they need it, we will be at their side. Because today, the real discovery is not so much about finding new lands. It's about looking with new eyes at the marvels of our planet, rekindling our sense of wonder, and acting to preserve our pale blue dot in the universe...

Doing our very beat for a Perpetual Planet.

#Perpetual



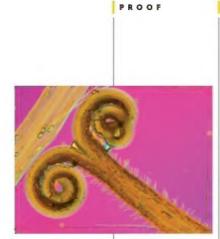
OYSTER PERPETUAL SUBMARINER DATE





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On the Cover A banded sea krait swims toward the surface for a breath of air at Blue Corner, a spectacular scuba diving site in Palau's Rock Islands Southern Lagoon. KILIII YÜYAN



Into the Woods By using a cameramounted microscope. a photographer zooms in on the branches, pine cones, and plants of a Canadian forestdown to their cells. PHOTOGRAPHS BY ROBERT BERDAN

EXPLORE THE BIG IDEA Exposing Hidden Marvels Through specialized techniques, photography can teach us to see the world in new ways.

FIELD NOTES

BY ANAND VARMA

Circling the Globe in Search of the Past Albert Lin, an adventurous engineer, seeks telling remnants of former civilizations. BY DANIEL STONE



Following the Fish Wild Flora at Risk

Where to Go Now See Calder mobiles in Seattle, a rainforest reserve in Cameroon, and a top view of a royal city in Vietnam. BY RONAN O'CONNELL

THROUGH THE LENS

Reprieve for Tigers A grueling investiga-tion into America's captive tiger industry ends with a ray of hope. BY STEVE WINTER, WITH SHARON GUYNUP

Pompeian Delicacies Armored Bird Nests



FEATURES

Pictures of the Year Diana Markosian's

portraits of young women who are shaking things up in Somaliland, Renan Ozturk's capture of an expedition vessel nearly swallowed by the seas of the South Atlantic—these are just a few of the most memorable images made by National Geographic photographers around the world in 2023. portraits of young

Fortress of Faith Get an insider's view of Spain's Alhambra. BY EMMA LIRA PHOTOGRAPHS BY JOSÉ MANUEL NAVIA ART BY FERNANDO G. BAPTISTA

Where Have All the Caribou Gone? Once robust herds are

rapidly declining. BY NEIL SHEA PHOTOGRAPHS BY KATIE ORLINSKY......P. 112

ABOVE: Marcio Pimenta photographed this taxi-dermied Darwin's rhea at the Maggiorino Borat the Maggiorino Bor-gatello museum in Chile while on a solo expedi-tion following the trail of Charles Darwin. Using the naturalist's travel journal as his guide, and with support from the National Geo-graphic Society, Pimenta covered more than 6,835 miles of land and sea.





BY NATHAN LUMP PHOTOGRAPH BY NICHOLE SOBECKI

AT NATIONAL GEOGRAPHIC We are fortunate to work with incredible photographers who canvass the globe to uncover stories that give us a new understanding of our world. Every day our team of skilled photo editors and designers combs through their images (sometimes thousands for a single story!) to choose the ones that do what great photographs do: convey information, yes, but also compel the eye and fill the heart.

Our annual tribute to this work, "Pictures of the Year," highlights a selection of our editors' favorite images from photographers in the field. It is not meant to tell a story of the year's most important moments, but to show what the world, in all its variety and richness, looked like

to our contributors. Perhaps unsurprisingly, you'll still find in these photographs many of the themes that are on all our minds: the shadow of war, the impact of climate change, the push-pull of modernity and tradition, the promise of science.

Also in our pages this month: an indepth survey of the iconic Alhambra in Spain, featuring a spectacular graphic exploration of the site by National Geographic senior artist Fernando Gómez Baptista, and an examination of North America's great caribou herds, which have been experiencing a precipitous decline that is not entirely understood. We hope you enjoy the issue.

One of the most captivating images from the past year was this Egyptian fruit bat flapping its wings inside a wind tunnel at Brown University. In her lab, biologist Sharon Swartz studies the biological and physical aspects of flight in various bat species.

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Neil Shea Based in Brooklyn, New York, Shea is an award-winning writer who works in print, film, tele-vision, and audio. He covers cultural and environmental shifts in places from Iraqi Kurdistan to East Africa. His book Frostlines: Dispatches From the New Arctic will be published by Ecco in 2025. Page 112



Emma Lira

A travel writer and specialist in Spain, Lira has authored his-torical fiction novels, a Lonely Planet Granada guide, and a National Geographic story on Tenerife's mummies. She's a res-ident of Madrid and the Canary Islands and leads small group tours for women throughout the Islamic world. Page 88



José Manuel Navia

Navia's images highlighting aspects of Iberian, Hispanic, and Andalusian cultures appear reg-ularly in *El Pais* and have been featured in the Spain edition of National Geographic for 25 years. His photographic essays are often based on authors he admires, capturing their literary landscapes. Page 88

NATIONAL GEOGRAPHIC EXPLORERS

These contributors have received funding from the National Geographic Society, which is committed to illuminating and protecting the wonder of our world.



Katie Orlinsky

During almost a decade of living in and visiting Alaska, Orlinsky has been During almost a decade of living in and visiting Alaska, Orlinsky has been examining the effects of climate change on the Arctic. Her images of its thawing permafrost appeared in the September 2019 Issue of National Geographic, and for this issue she hiked solo for days in a remote stretch of Alaska to document migrating caribou. When a wolf approached briefly, Orlinsky was thrilled for the company, she says. The June 2023 cover story featured her photographs of the world's first designated wil-derness area, in New Mexico, She became an Explorer in 2022. Page 112



In the woods near his childhood home in Atlanta, Varma discovered In the woods near his childhood home in Atlanta, Varma discovered his passion for being immersed in the natural world. Then he picked up his father's camera and found a way to share that enthusiasm. Now living in Berkeley, California, Varma has spent years developing innovative photography techniques to reveal aspects of science and nature, such as the rapid motions of hummingbirds, that normally go unseen. An Explorer since 2010, he's also a TED speaker and a World Press Photo award winner. Page 17

The following Explorers contributed photographs to "Pictures of the Year," beginning on page 36:

David Doubllet, Yagazie Emezi, Jen Guyton, Robin Hammond, Davide Monteleone, Matthieu Paley, Louie Palu, Thomas Peschak, Carsten Peter, Marcio Pimenta, Jaime Rojo, Alexander Semenov, Chinky Shukla, Nichole Sobecki, John Stammeyer, Brent Stirton, and Kililii Yūyan.



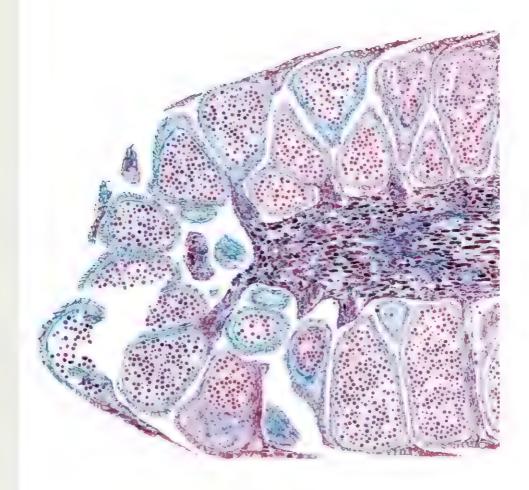
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NATIONAL GEOGRAPHIC



PHOTOGRAPHS BY ROBERT BERDAN

LOOKING AT THE EARTH FROM EVERY POSSIBLE ANGLE



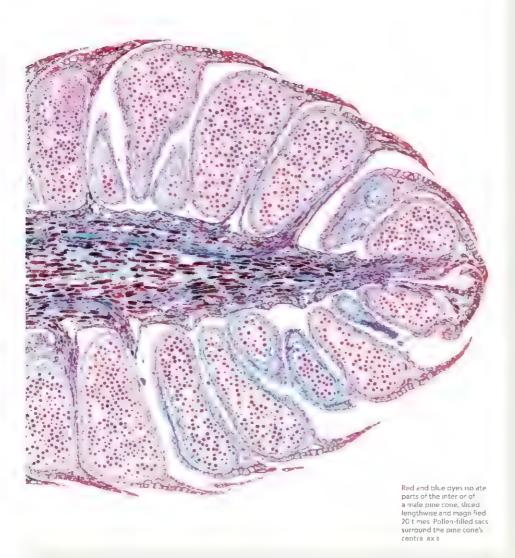
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ARTICLE

INTO THE WOODS

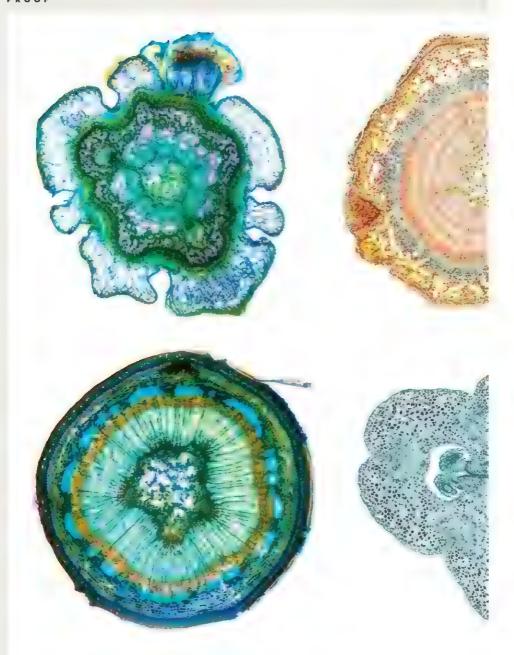
With a camera-mounted microscope, this photographer revea s the cellular world inside a forest.

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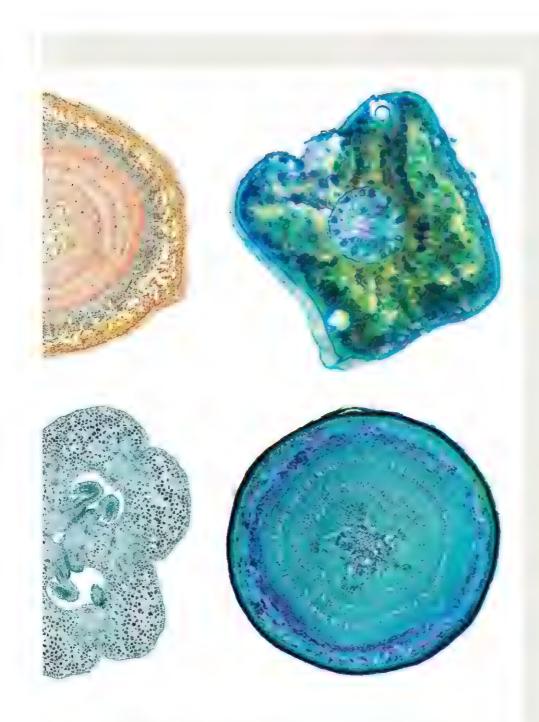
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PROOF



In Robert Berdan's lab, tinted slices of plants transform into kale doscopic works of artiechoing agate or stained glass. Als technique, known as photomicrography, involves photographing dyed specimens under a microscope fitted with a DSLR camera.

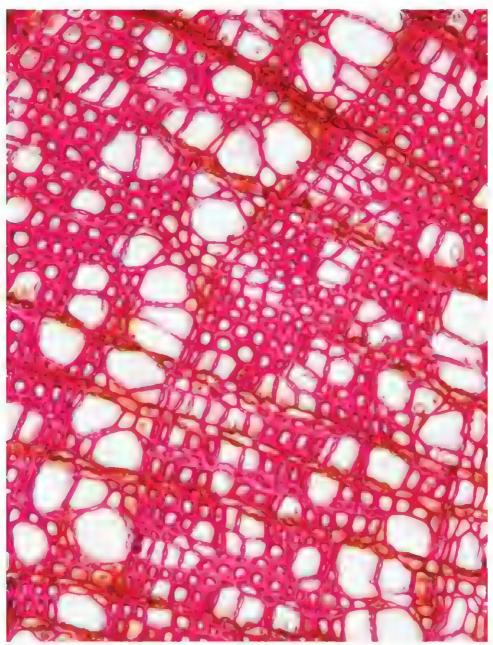
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Seen here clockwise from top left spruce branch, pine stem, showing four distinct growth rings, spruce needle, pop ar branch brown illy ovary, pop ar branch at greater magnification

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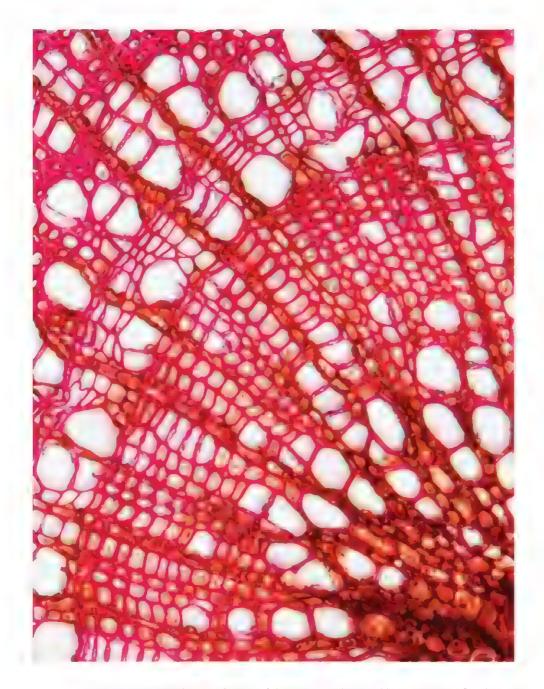
PROOF



Thinly sliced, tinged with red, and photographed at 400 times magnification, a popiar branchical sito mind not wood but macrame if became interested in photography because livened to share what is saw in the microscope," Berdan says. In this

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ARTICLE



image, parenchymaice is, which are the foundation of all plant tissue, resemble holes, while a banding pattern reflects the tree's annual growth "Plants are more complicated than most of us imagine," he says.

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THE BACKSTORY

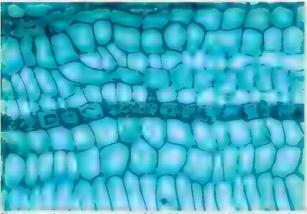
AS A CHILD, THIS PHOTOGRAPHER GOT A CLOSE UP LOOK AT THE NATURAL WORLD HE'S BEEN ENTHRALLED EVER SINCE

GROWING UP ON the shores of Lake Huron in the Canadian province of Ontario, Robert Berdan was never far from water. When he was in sixth grade, he received a toy microscope for Christmas. Some of the first things he saw through its lens were tmy creatures inside droplets he'd gathered from a local pond. He was fascinated with the microorganisms.

After eighth grade, Berdan upgraded to a more sophisticated model and realized it was a portal to another world. "The new microscope changed my life," he says. "I could see so much more." He began studying photography and buying cameras to fit on his microscope. He captured images of ferns, mushrooms, and trees, and learned how to develop film. He also developed his microscopy skills, so much so that he earned a doctoral degree in cellular biology and spent five years running a lab at the University of Alberta in Edmonton.

But Berdan never forgot his two early passions—being immersed in nature and photographing its tiny details—and he decided to return to them. His subjects range from snowflakes to spruce trees. To see the latter under a microscope, Berdan collects a small branch and wields specialized tools to shave off paper thin slices, which he dyes red or blue. For the final images, he often uses a process called focus stacking, in which similar photos with different focal planes are blended to achieve a more profound depth of field, and he sometimes stitches photos together to create panoramas.

"I investigate anything that might have possibilities," he says And he encourages others to do the same with a microscope. "Any tool that amplifies our ability to see will enhance our creativity," he notes. "Our observations can potentially lead to new discoveries and solutions." —CATHERINE ZUCKERMAN



Bue pigment adds an icy hue to this view of the ceilular structure within a pop ar branch

EXPLORE

IN THIS SECTION
P'zza n Pompeii?
Wild Plants to Know
Calder Extravaganza
On the Tiger Beat



LLUMINATING THE MYSTERIES AND WONDERS ALL AROUND JS EVERY DAY

NATIONAL GEOGRAPHIC

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Exposing Hidden Marvels

WITH ITS ABILITY TO CAPTURE SIGHTS INDISCERNIBLE TO THE HUMAN EYE, PHOTOGRAPHY CAN 'TEACH US TO SEE THE WORLD ANEW.'

BY ANAND VARMA



AS A KID, I DREAMED of becoming a marine biologist and living my life by the sea. Since I grew up in a landlocked suburb of Atlanta, I lived out this fantasy by setting up aquariums at home. At 14, I started working at my neighborhood aquarium shop. By 16, I had seven fish tanks at home. Then, at 20, I was introduced to photographer David Liittschwager, who hired me to help him with a National Geographic magazine assignment on marine life.

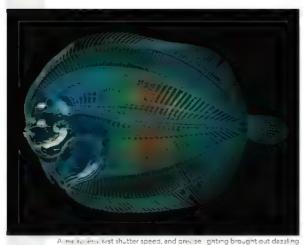
We spent 10 days aboard the Oscar Elton Sette, a 224-foot NOAA research vessel sailing off the Kona coast of Hawaii. David's assignment was to document the astounding biodiversity found at the surface of the ocean. My role was to collect specimens for him to photograph.

Every night after the Sette had completed its sci entific mission, I would cast a floating lamp off the port side of the ship. Like moths drawn to a flame, mysterious creatures would emerge from the depths

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in search of this light. Shimmering baby eels, tiny transparent crabs, sparkling squid. I'd carefully select an ambassador for each species and set up aquariums to house them as they waited for David to take their glamour shot.

Those evenings aboard the Sette made me feel as if I were on another planet. At the end of each night, I'd sit and marvel at my dazzling collection. I had never imagined such bizarre life-forms could exist in our oceans. My eyes were glued to the tanks, my attention absorbed by these alien beings. But I didn't grasp the true magic of what was in front of me until I saw the photographs David took of these creatures I'd been gathering.



details in this young flounder that weren't initially apparent

The biggest surprise was his image of a baby flounder, seen above. I caught this fish by accident, scooping it up as I was chasing some more obvious target. Only later, when I inspected the contents of my collecting jar, did I notice its two tuny eyeballs staring back at me. The only other feature I could discern was the faintly wriggling outline of its transparent body.

But David's photograph of this flounder revealed a universe of detail that even my eager eyes had missed. His macro lens magnified its finely articulated ribs. The lightning-fast exposure froze its motion, providing a crisply defined view. A precisely aimed light released the rainbow hidden in the flounder's skin. And the black background eliminated all distractions to focus our attention on the quier beauty at hand.

Years after that project in Hawaii, I was snorkeling at night on a shallow reef in French Polynesia. Out of the darkness, another baby flounder emerged and settled on my mask. This time I knew what to look for. I angled my flashlight toward the little fish and saw the shimmering colors and delicate bones that David's image had first revealed to me.

Before working for David, I had assumed the goal of photography was simply to reproduce an observation so that others could share the same experience. It had never occurred to me that photography could expand our visual perception and thereby teach us to see the world anew.

SIZE. TIME. LIGHT. FOCUS. These are the features of David's photograph that expanded my understanding of that small flounder. And these are the tools that photography gives us to witness and reveal the world's invisible wonders.

For example, size. When editors at National Geographic asked me to photograph a story on honeybees, I was not excited to take on the assignment. The tiny pollinators had already garnered so much media attention that I couldn't imagine how I could contribute anything new. But as an insecure young photographer, how could I say no? So I faked some enthusiasm and landed a job I had no idea how to accomplish.

I started by learning how to keep bees in my Berkeley, California, backyard, hoping that with enough time and study, I'd discover some new way of portraying their lives. One day I noticed something out of place: A young bee had become trapped as it was emerging from the hive. Using a trick I'd learned from an entomologist, I plucked one of my eyelashes and used its thin, flexible tip to brush a bit of debris away from the bee's face. Then I placed a light behind the hive to make the surrounding wax glow.

The bee's position allowed me to bring my camera close and capture features on its head I hadn't noticed before, like its jointed antennae and furry face. I'd spent a year tending to my hive—but until that moment I'd never experienced a bee this way. Once we were brought eye to eye, the intumacy inspired new questions. How does this creature perceive its environment? What do I look like to it? Why all the hair?

We tend to relate best to beings our own size, or at least creatures we can see with an unaided eye. When photography magnifies a subject, it can break that barrier. That opens us to entirely new perspectives.

THERE'S SIMILAR POTENTIAL in time. In 2015 I met bat expert Rodrigo Medellín in Mexico's Yucatán Peninsula, where his team had located a family of woolly false vampire bats, one of the largest species in the Americas. National Geographic wanted me to photograph the bats, and Medellín asked me to bring an enclosure so we could work with them in captivity. I brought a collapsible batting cage used for

PHOTO: DAV D LHTTSCHWAGER



A COMPELLING PHOTOGRAPH CAN CHANGE US. IT SHAPES WHAT WE NOTICE, CHALLENGES OUR ASSUMPTIONS, AND EXPANDS OUR CURIOSITY.

baseball practice and set it up at the foot of my hotel room bed. We then released a captured bat inside.

Bats' speed and stealth make them nearly impossible to track with a camera. But Medellin used a clever technique of enticing the carnivore to fly across the cage on command, using bits of raw chicken as a reward, and that allowed me to predict where it would be and when. I set the camera to take an image over a third of a second, knowing this would record only a blurry trace of the bat's swift movement. But before the camera completed its exposure, I triggered a brief flash of light, creating a crisply defined image of the bat superimposed onto its impressionistic form.

We often assume a photograph can capture only a single moment, yet that image simultaneously illustrates two different time intervals—in a sense, one too fast for us to see and the other too slow. Our natural perception lies somewhere in between, as a series of moments strung together into a movie whose pace we cannot change. Photography gives us unique and flexible means to explore and portray time's passage.

AS FOR LIGHT, see how fog transforms traffic signal beams in Lucas Zimmermann's long exposure, shown at right. Every photograph is a collaboration with light. Photographers position light in clever ways or manipulate it to reveal hidden patterns. Using cameras' capacities to detect colors invisible to the human eye, they broaden our sensory experience.

And focus? Broadly defined, focus is how photog raphers direct our attention, with technical skill and thoughtful composition that compel us to slow down and consider the layers of complexity and detail in a scene that we might miss at first glance.

When I first decided to pursue photography, I thought I'd have to abandon my childhood dream of being a scientist. But the longer I work in both realms, the better I understand how each reinforces the other. That's the principle behind WonderLab, a research center I recently established (see sidebar).

I believe a compelling photograph can change us. It shapes what we notice, challenges our assumptions, and expands our curiosity. It motivates us to make room for new ideas and enlarges our circle of compassion. A beautiful, bewildering photograph is a wonderful place to start making sense of the staggering complexity around us. □

This essay is drawn from **Anand Varma**'s 368 page coffee table book, *invisible Wonders: Photographs of the Hidden World.* It's available wherever books are sold

Where Science and Photography Join Forces

After National Geographic published my photos of noneybees in May 2015, a scientist told me I had captured undescribed bee behavior in pursuit of unique images, had stumbled onto an original observation. That's when I realized that science and photography aren't mutually exclusive efforts. Science gives us structured systems for observing the world, while photography gives us tools for extending our visual perception.

To narness the combined power of both, velaunched an enterprise called WonderLab, in Berkeley, California, it draws on my training as a biologist, my experience as a photographer, my fondness for tinkering, and my desire to share what I'velearned it's a science lab, a photography studio, a makerspace, a classroom ideally. WonderLab will inspire new ways of visualizing science—much as an exceptional photographigives us a fresh look at our wor of Tollearn more, visit natgeology/wonderLab.—AV



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PHOTOS: LUCAS Z MMERMANN (TOP): HELENE SCHMITZ (LEFT' TIM FLACH (RIGHT)

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Canary Islands: Eight paradises, and the legend of a ninth

Each of the Canaries is a world unto itself, with its own distinct landscape, wildlife, and culture. And there are even whispers of one more undiscovered island...

Of the eight inhabited Canary Islands, each has its own discrete natural history. All have belonged to Spain for more than half a millennium now, and the weather is consistently warm, mild, and clement across the whole archipelago.

One particular story has been told for as long as anyone can remember. The legend of a ninth. Often drawn onto past maps and charts, the spectral isle of San Borondón was named after the mystic Irish monk known as Saint Brendan the Navigator. Spreading Christianity across the seas in the 6th century, he was guided by a giant fish to a kind of heaven on Earth at the far end of this archipelago. Happening upon any of the Canary Islands today, a modern voyager will encounter an earthly paradise of incredible variety

Ringed by yellow and black sand beaches, Tenerife is also quietly spectacular through inland forests and farmlands, ascending to the snowy, starry summit of Mount Telde. This mightiest volcano of the whole archipelago casts a long shadow over the sea, which is one possible source of the San Borondón legend.

Lively with commerce, music, and a flourishing gastronomic culture, Gran Canaria arrays some of its deepest natural pleasures across the hidden reaches of a dynamic topography. Volcanic crags, abyssal caves, towering dunes, ancient pines, and rolling green hills create a "miniature continent" unto itself.

Lanzarote's UNESCO-protected biosphere pushes most human activity right to the margins at busy ports and lively coastal resorts. The beautifully eerie interior now draws ever-more hikers and cyclists to otherworkly massifs, plains, volcanic cones, and tunnels.

Fuerteventura has been shaped over eons by strong breezes that have whipped up sand dunes into soft looming peaks. Conditions are optimal for surfing and other watersports off golden beaches, while backroads wind their way to hidden coves and conservation areas for birdlife or sea turtles.

PAID CONTENT FOR SPAIN TOURISM BOARD



Left hand page: Gran Canaria is a traveler's paradise of golden beaches, but its interior conceals a treasure trove of natural wonders Top right: Celebrated with painted costumes and devilish masks, the diabletes (little devils) carnival has been held on Lanzarote for several hundred years. Bottom right: Lanzarote's Timanfaya National Park is a Lunar-like landscape of lava fields, smoxing craters, and peaks formed by volcanic eruptions hundreds of years ago. Map by: Guillermo Trapiello.

Lively with commerce, music, and a flourishing gastronomic culture, Gran Canaria arrays some of its deepest natural pleasures across the hidden reaches of a dynamic topography.

On La Palma, wood-fronted houses rise out of the harbor on a wave of solid lava, while Latin style carnivals and hand-rolled cigars attest to a long history as shipping hub between old and new worlds.

Once the island at the edge of the known world, El Hierro's many cliffs drop away abruptly into deep waters now known for prime dive spots. A certain primeval atmosphere abides in volcanic pools and thick laurel forests, especially where local legends tell of witches gathering for ritual dances.

Among the smallest, wildest, least-visited Canaries, La Gomera rises from beaches and palm groves to misty cloud forest. Unpopulated as it is, the island still bears living witness to its distant pre-Christian past by way of the native "whistling language", Silbo Gomero.

La Graciosa is one of Europe's last outposts without asphalt roads. A few whitewashed houses and summer residences are scattered between deep blue undersea caves and terracotta-colored volcanic ranges, where native bird, fish, and lizard species far outnumber humans.

Discover your paradise:



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ARTICLE

DISPATCHES
FROM THE FRONT LINES
OF SCIENCE
AND INNOVATION

The perfect revenge

To dissuade birds from fouling buildings, owners sometimes line ledges with strips of steel spikes. But clever Eurasian magpies rip the spikes from structures and use them to top their nests, possibly as protection against crows, a new study finds. —JASON BITTEL





ANIMAL REHAVIOR

NEW ANGLE ON MANNERS

WHEN THE GOING GETS TIGHT, THESE FISH HAVE AN UNUSUAL ABILITY TO SLOW DOWN AND QUEUE.

A species of tiny freshwater fish found in the Amazon Basin and in home aquariums around the world was discovered to possess something that a surprising number of people appear to lack: the ability to wait their turn. In a new study published in Scientific Reports, researchers ushered schools of neon tetras (Paracheirodon innesi) through a narrow opening in their tank and found that the fish used queuing to navigate the close quarters without clogging up and impeding passage. The "courteous" creatures, which are only about an inch long, did not collide into one another as they swam near the opening. While the dexterity to exit without bottlenecking has been observed in ants, no other animal was known to have the skill. The study's authors believe that the neon tetras' seemingly polite behavior might have evolved to help them pass between rocks in their river hab itat. These findings, the authors say, could be used to improve traffic-control strategies for autonomous cars- and perhaps for crowds of people too. -Annie Roth

ARCHAEOLOGY

Pizza in Pompeii? Sort of

Several months ago, when archaeologists in Pompeii revealed a 2,000 year old fresco showing what they be eve to be a flat piece of focaccia w tn toppings, it wasn't quite the pizza we know and love While the protop zza m ght nave nad garn shes, tomatoes d dn't ex st yet in Europe. Pompe ans a a use garum, a salty fish sauce, as "ancient ketchup" and dined on stuffed dormouse as a delicacy. - CHRISTINA STERBENZ

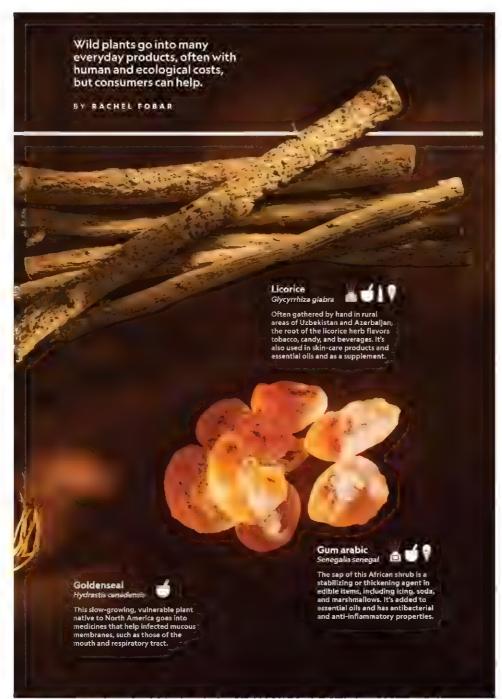


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food supplements, and natural beauty products—is booming. U.S. consumers spent more than \$12.3 billion on herbal dietary supplements in 2021—up more than 9 percent from 2020. Plants such as licorice can be found in herbal preventives and remedies for COVID-19, and bark from the soapbark tree, endemic to Chile, is in the Novayax COVID-19 vaccine.

Wild plants have been used locally for centuries—frankincense in the Horn of Africa, Brazil nuts in South America, baobab powder in southern Africa—but today's global demand puts many at risk. And international customers often have no idea where these products originate.

Should consumers stop buying the products? No, Schindler says, because "the ingredients are really critical to a lot of people's livelihoods." Solutions for transforming the trade in wild plants are rooted in awareness. The first step for consumers is to "just notice that you're buying something that has a wild ingredient," she says. It's generally safer to purchase local products and splurge on more expensive ones, if possible.

Consumers can also look for organic and fairtrade certifications. Various programs evaluate wild-plant supply chains for sustainability and employment conditions, and many companies advertise these certifications, either on the product or online. One of the most prominent is FairWild, which assesses both human and environmental risks and recommends best sourcing practices. Other programs include the Forest Stewardship Council, the Rainforest Alliance, Fair for Life, and the Union for Ethical Biotrade. If certifications are missing, Schindler encourages people to challenge companies to do better. "Until businesses get a bit more pressure from consumers, we won't see any changes happening," she says.

"Historically, the medicinal plant industry has had a lot of secrecy in it," says Ann Armbrecht, director of the Sustainable Herbs Program, which supports transparency in herb sourcing. She says that when she got her start in this field, "there was so much discussion about where food came from, and nobody was asking where the chamomile in their [tea] came from." Companies don't want to share proprietary information, and consumers don't think to ask.

By using contact information on company websites, consumers can pose questions: Do you source organic and fair-trade ingredients? Do you or your suppliers make site visits to the communities where your products are grown? What are you doing to combat climate change?

Companies that don't make the effort to learn about the sources of their ingredients, Armbrecht says, will start doing so if consumers demand it.

Rachel Fobar is a reporter for Wildlife Watch, our invest gative reporting project focused on wild ife crime and exploitation it's supported by the National Geographic Society.

RANGES OF CONCERN

In recent years the global trade in wild plants has skyrocketed. As species are exploited, dangers to biodiversity and local workers have also risen.

Environmental **

Overharvesting of the plants—along with climate change, habitat loss and disease—can lead to species extinction.

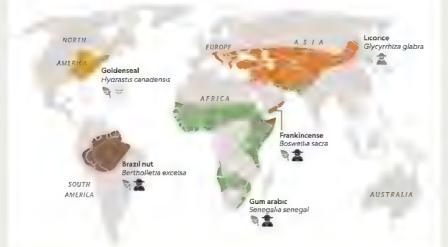
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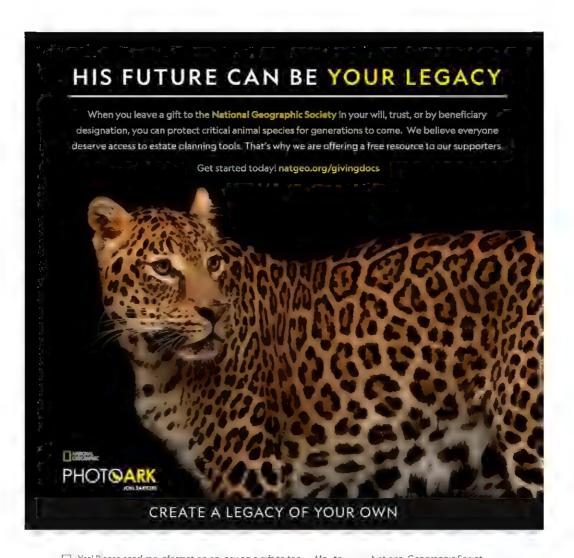
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Laborers collecting the plants can face a range of difficulties, including environmental haz ards, humanir ghts abuses and poor pay



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CIRCLING THE GLOBE IN SEARCH OF THE PAST



A bert Lin perches on a cliff edge while seeking traces of the Cloud Warrior people in Peru

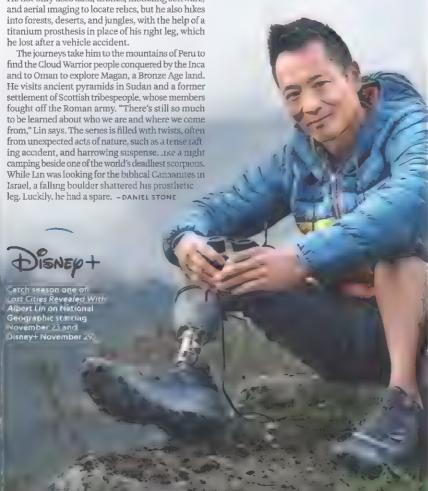


PHOTO: ROCIO LIRA SALAS, MAT JINAL GEOGRAPHIC FOR DISIVEY



WHAT'S NEW AND NOTEWORTHY AROUND THE WORLD From luminous craftsmanship in Britain to conservation in Cameroon.

BY RONAN O'CONNELL



1

RARE WINDOWS

The Endangered Art of Stained Glass
For 900 years this style of window has bathed Brit sin castles and cathedrals (such as Liverpool's, below) in co orful, dappled light But a recent report reveals that fewer than 60 stained-glass makers remain in the United Kingdom, primarily because of rising material costs and fewer study pathways for prospective artisans. A new youth-recruitment drive aims to secure asting production of these prec ous panes.



2 AFRICAN CAMEROON'S
KORUP RAINFOREST
RECENTLY BECAME A
UNESCO BIOSPHERE
RESERVE. THE MANA
RIVER FOOTBRIDGE
LEADS INTO THE
PARK, HOME TO
UNIQUE FLORA AND
THE CRITICALLY
ENDANGERED CROSS
RIVER GORILLA.



A TRAINED mechanical engineer, Alexander Calder pioneered the mobile, a sculpture that moves via motors or air currents. His 1948 "Dispersed Objects With Brass Gong" (above) is in a collection of 62 works by the late American artist displayed together for the first time at the Seattle Art Museum, in Washington. "Calder: In Motion, the Shirley Family Collection" will be part of a multiyear project exhibiting the innovator's mobiles, stabiles, wire sculptures, and oil paintings. His 39-foot-tall, bright red, steel "Eagle" already roosts permanently ın Seattle's waterfront Olym pic Sculpture Park.



IMPERIAL VIEWS

Towering walls ring Hue's Imperial City, the hub of Vietnam's Nguyen dynasty (1802-1945). A new walkway allows tourists to view the citadel from atop a part of those fortifications, including the majestic temple The To Mieu and its entrance gate (right) protected by statues of dragons, unicorns, phoenixes, and turtles.



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Young rescued tigers Clay, Daniel, and Enzo rest after some vigorous play at the Wild Animal Sanctuary in Colorado.

BIG CATS GET A REPRIEVE

A GRUELING FORAY INTO THE UNDERBELLY OF AMERICA'S CAPTIVE-TIGER INDUSTRY ENDS WITH A RAY OF HOPE.

BY STEVE WINTER, WITH SHARON GUYNUP

our two-year investigation into captive tigers in America sent us through 32 U.S. states—with some truly disturbing experiences. But as the deadline for our *National Geographic* story loomed, I still needed a powerful, hopeful image.

When we began our reporting in 2017—Sharon, writing; me photographing; and our son, Nick Ruggia, filming—more tigers likely lived in cages in the U.S. than remained in the wild. Estimates ranged from 5,000 to 10,000, but with lax government oversight, no one knew for sure. There was no federal law regulating big-cat ownership.

Roadside zoos that allowed tourists to cuddle and shoot selfies with cubs were at the root of what's been

called a U.S. tiger crisis. Captive-bred cats often ended up in the illegal wildlife trade. To maintain a constant supply of babies, tigresses were forced to churn out litter after litter. Cubs, wrenched from their mothers at birth, were fed poorly and handled by hundreds of people. When they grew too big and dangerous to pet at around 12 weeks, cubs became breeders, were put on display, or simply disappeared. Many of these venues passed themselves off as sanctuaries. At least one made a million dollars or more in annual revenue.

Zigzagging the country, we interviewed hundreds of people for the story, including owners, workers, and customers at both roadside zoos and true sanctuaries, as well as wildlife biologists, conservationists,

PHOTO STEVE W NTER

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prosecutors, and U.S. Fish and Wild life Service agents. Sometimes we went undercover, sometimes not.

We filmed and photographed cub petting at run-down zoos, a high-end safari show, an Illinois county fair, and an Oklahoma living room. We saw sick, skeletal tigers—some scarred, cross-eyed, or disabled—living in squalid quarters. We discovered illicit activities, including animal abuse, donations used for personal profit, and wildlife trafficking, which drives poaching of the last wild tigers.

Sharon corresponded with Joe Exotic, the infamous "Tiger King" who's now serving a 21-year sentence for murder for hire and falsifying

criminal records, as well as killing and trafficking tigers at his former G.W. Exotic Animal Park in Oklahoma. I spent nine days photographing Bhagavan "Doc" Antle and his Myrtle Beach Safari attraction. In June 2023 Antle was convicted of felony wildlife trafficking and conspiring to traffic in wildlife.

While we documented the underbelly of this industry, we also wanted to show the best life these magnificent apex predators—unable to be released into the wild—could have in captivity. With two weeks left before my deadline, I headed to the Wild Animal Sanctuary near Denver, where well-nurtured cats roam acres of habitat.

There I met Clay, Daniel, and Enzo, three of 39 tigers



AWARD WINNERS

The prestigious annua El za Scidmore Award for Outstanding Storytel ing is presented by the National Geographic Society

Geographic Society
The award is named for
the writer and photographer
who, in 1892, became the
first woman elected to the
Society's board in 2024
the award wil recognize
Nationa Geograph c
Exp orers Steve Winter and

Exp orers Steve Winter and Sharon Guynup for their compelling investigative reporting on the plight of captive tigers in the U.S rescued from Joe Exotic's former zoo. These huge, nearly grown cats frolicked, racing beside our ATV as we drove the fence line and sparring on their hind legs—behavior I'd seen only in wild tigers.

It was a steamy July day, and soon two of the cats jumped into a stock tank to cool off. The third settled beside them on the ground. I crossed the road to shoot pictures of another tiger, framed by a patchwork of blue sky and gray clouds, with the last rays from the sun streaming through as it dipped behind the Rocky Mountains.

Then I heard my assistant loudwhisper, "Steve, you said you wanted a rainbow. You got one!" I crawled

back toward the trio, trying not to disturb them, and slipped my lens through the fence. The third cat laid its head against the tank, and I had the shot: three contented tigers, framed by a rainbow.

When the story ran in 2019, members of Congress who'd sponsored legislation regulating big cats received a copy. Three years later, the Big Cat Public Safety Act became law, prohibiting private owner ship in most circumstances and public hands on contact. The U.S. cub petting industry is now a thing of the past. \square

Steve Winter photographed and Sharon Guynup wrote "The Tigers Next Door," which ran in the December 2019 issue of the magazine.



Writer Sharon Guynup captures photographer Steve Winter in action with a self e taken atop Elephant Rock during recent fieldwork in Sri Lanka. The team works together to document the challenges facing big cats and other animals.

PHOTO SHARON GUYNUP

NATIONAL GEOGRAPHIC

DECEMBER 2023

P ctures of the Year P 36 Alhambra's Legacy P, 88 Dwindling Car bou P, 112

FEATURES

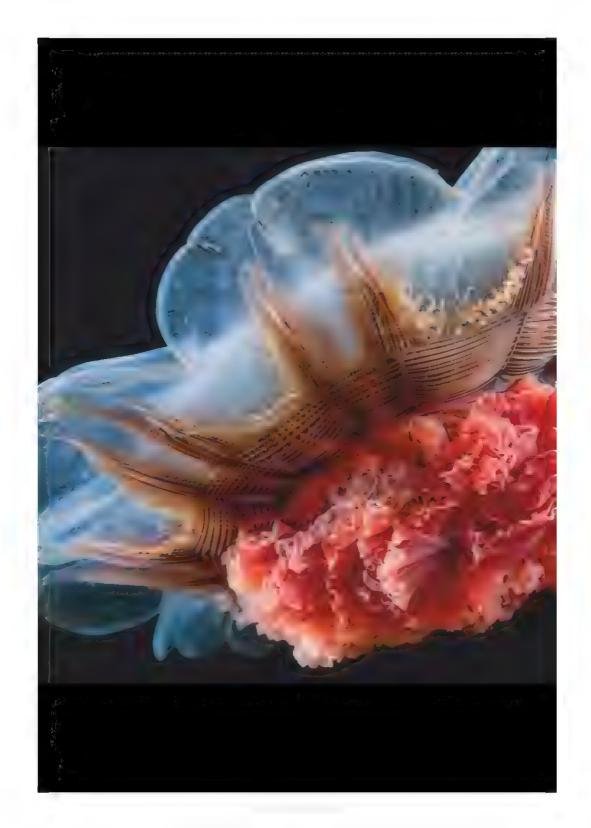


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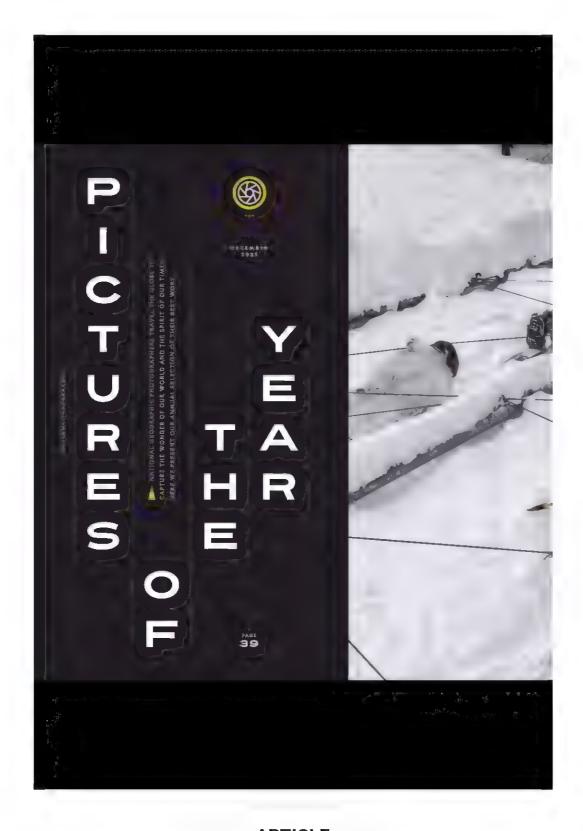
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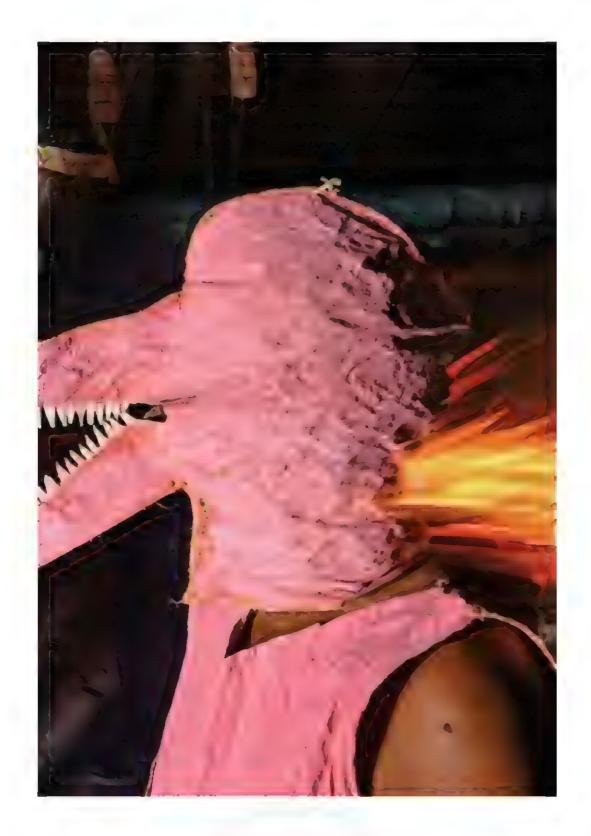
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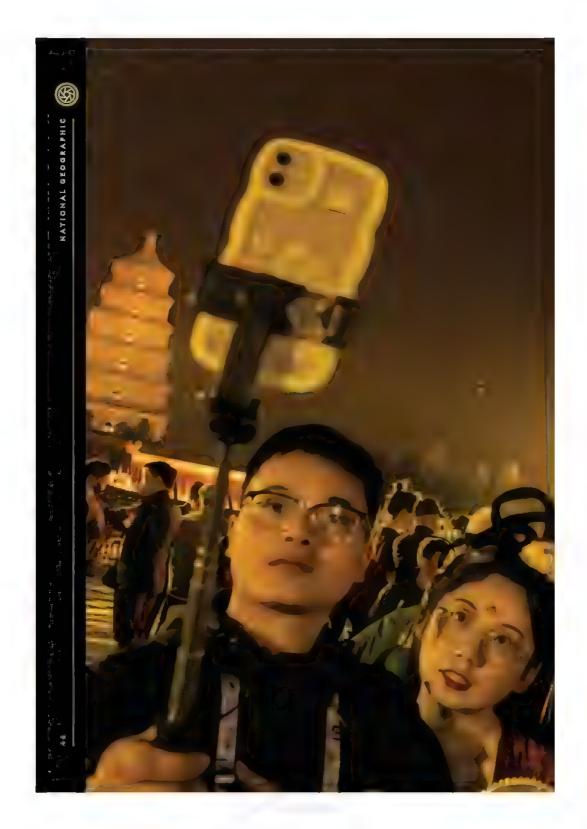
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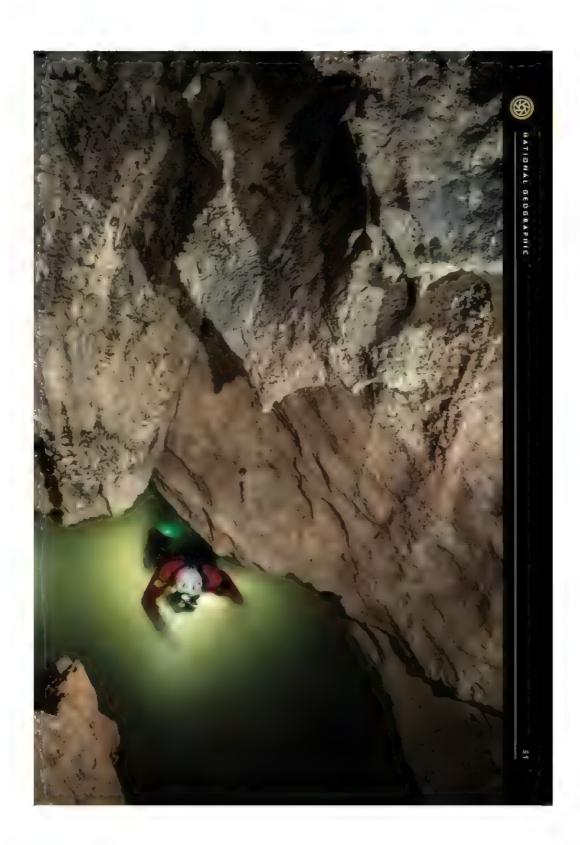






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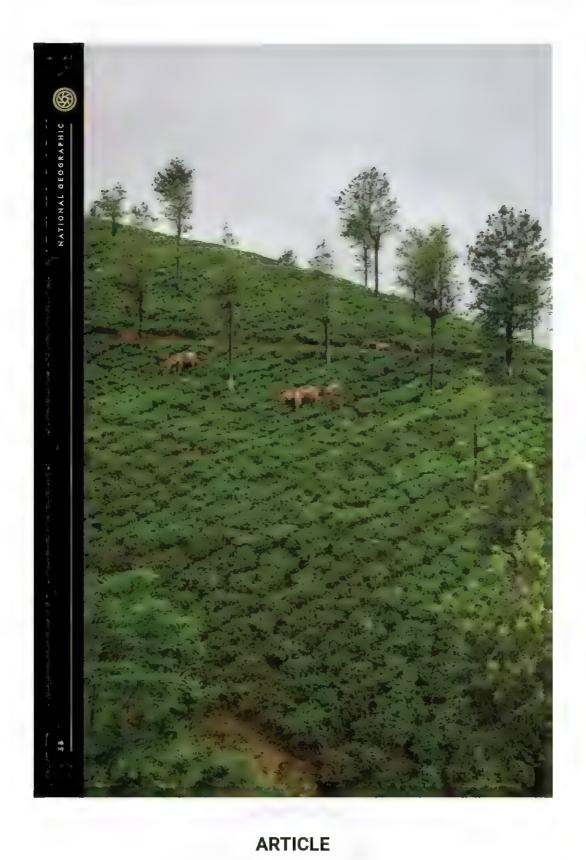
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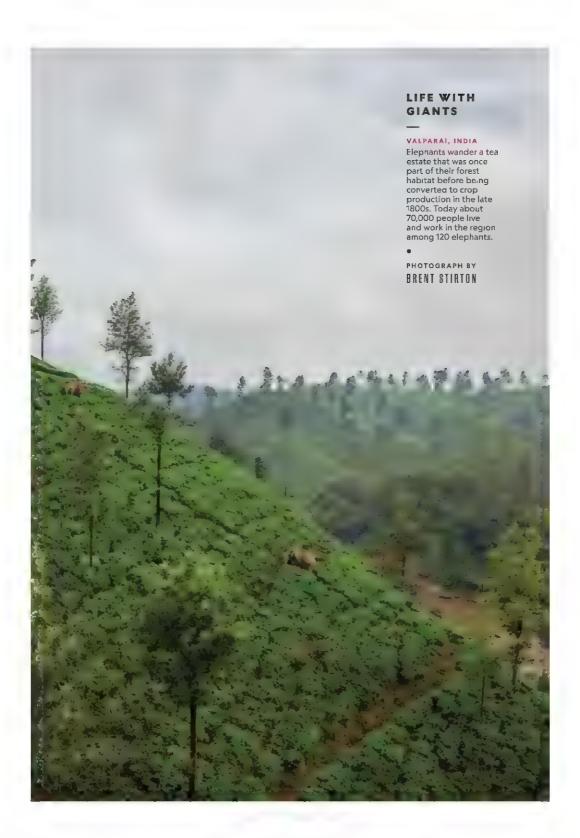
Markosian traveled to Somailland—an unrecognized, self-declared state within Somaillanthree decades after the country emerged from civil war. She found plenty of youthful energy: "I met a generation of girls who are mixing things up and reshaping culture while also maintaining tradition." Left: Hafaa Omar, 20, and her sister Asma, 18 (holding ball), play on a women's basketball team and attend university. Hafaa also works digitizing cassette tapes and other media containing music, speeches, and more, Right: Suhuur Hassan, 19, and Muhim Mawliid, 20 (looking at camera), study traditional donce at Hargeisa's Halkar Academy.

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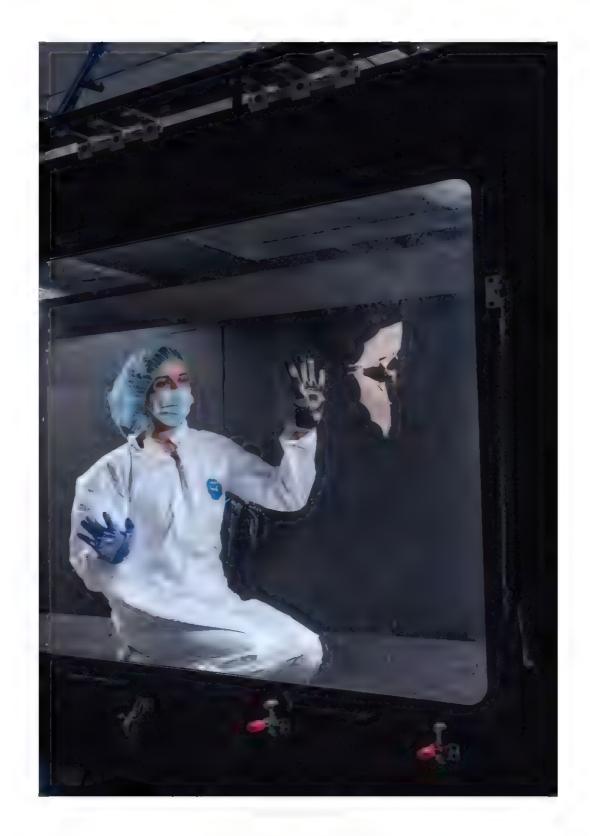




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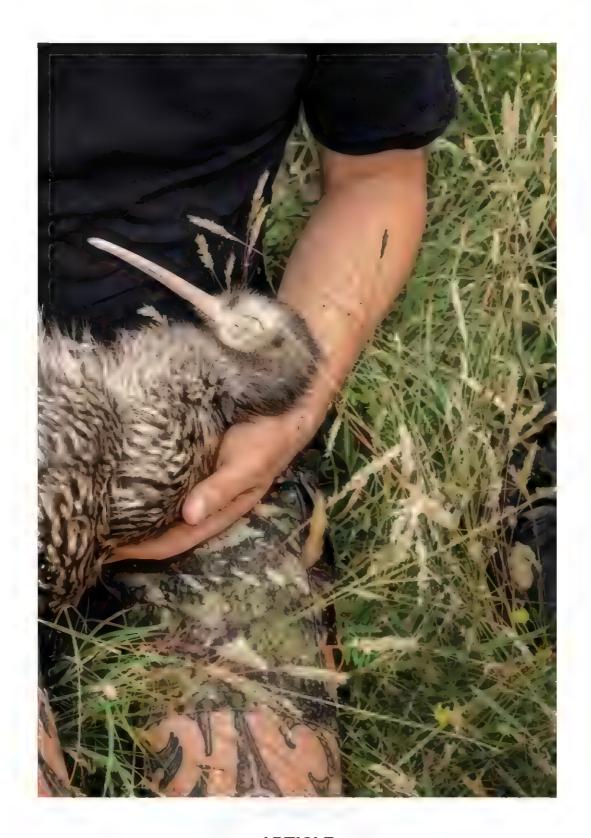
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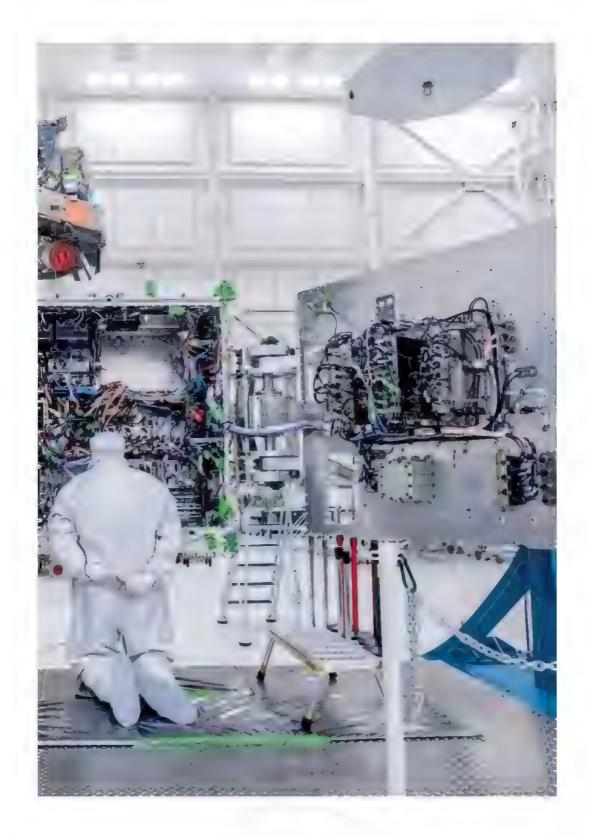
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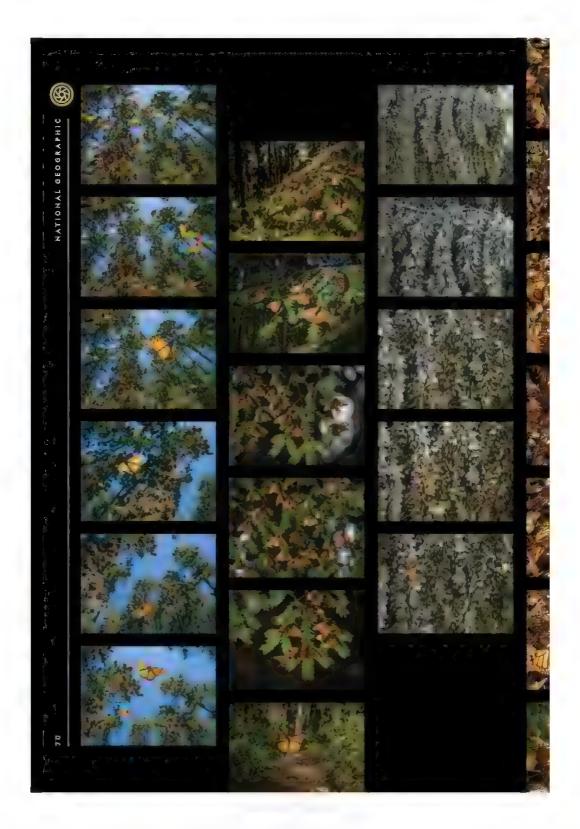
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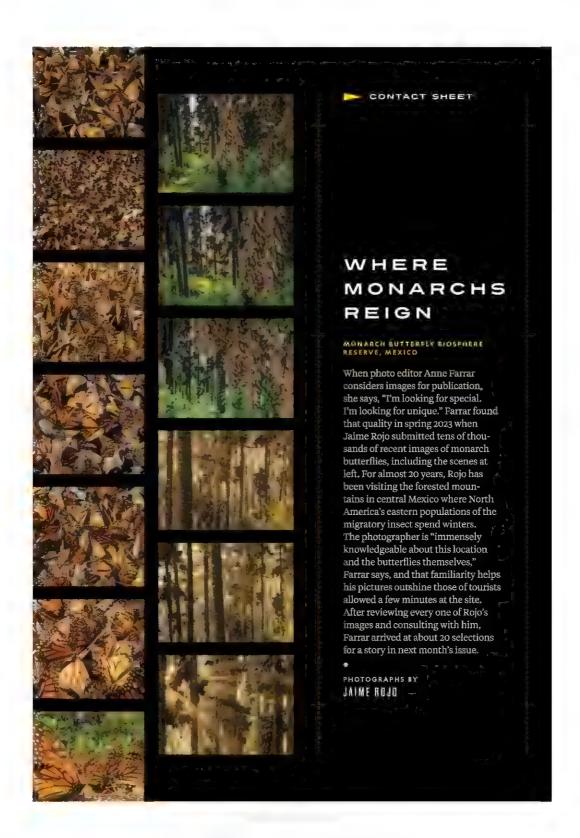
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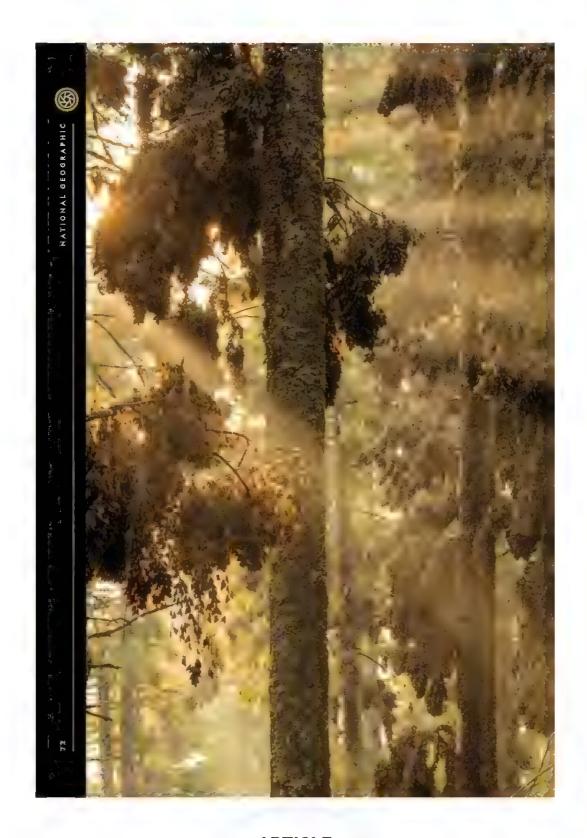


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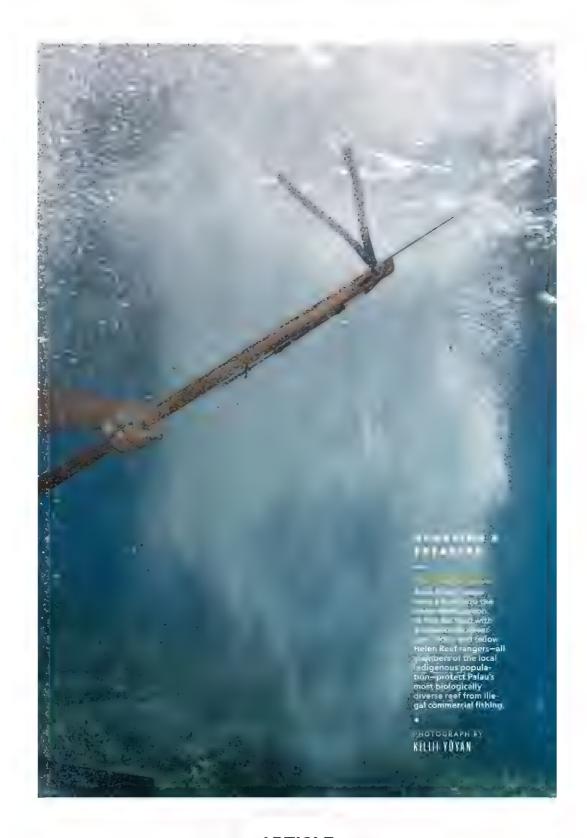
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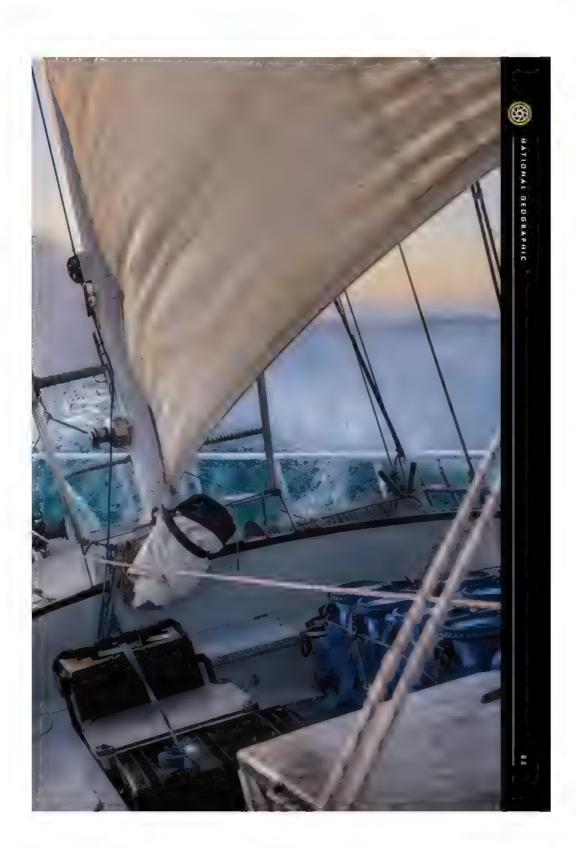




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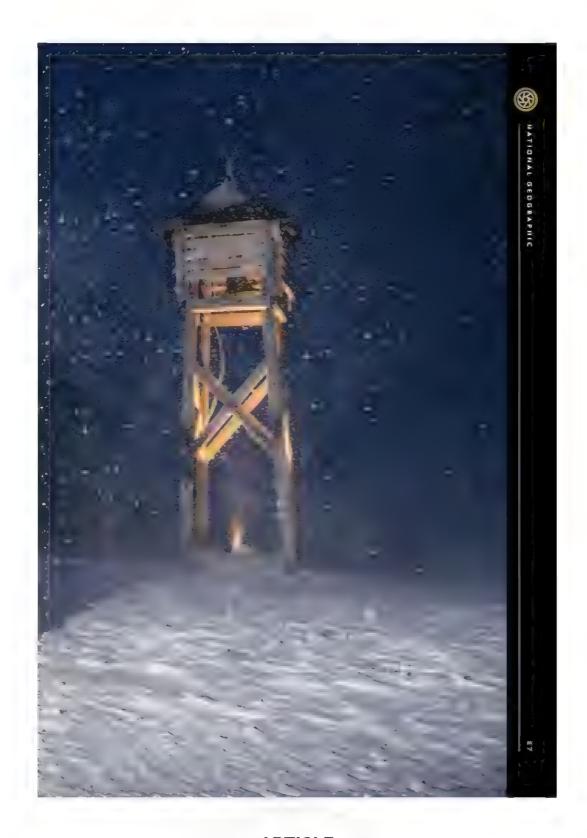


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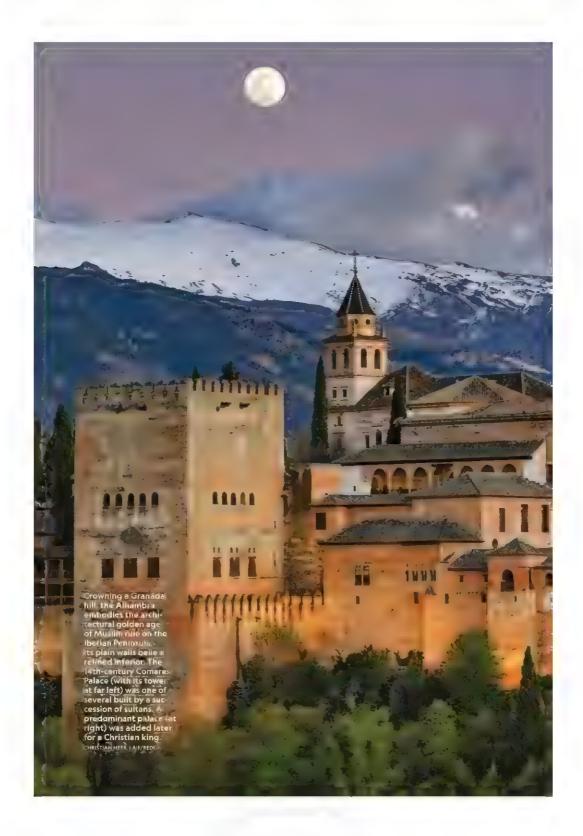




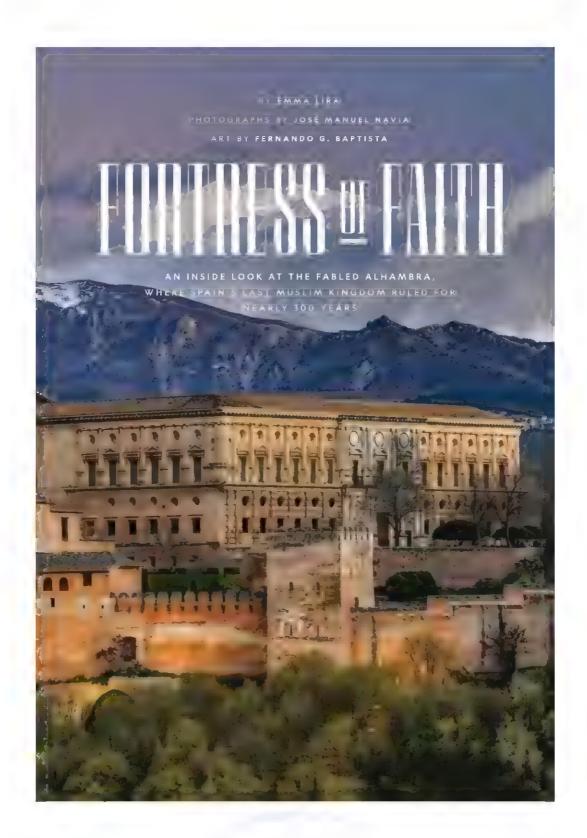
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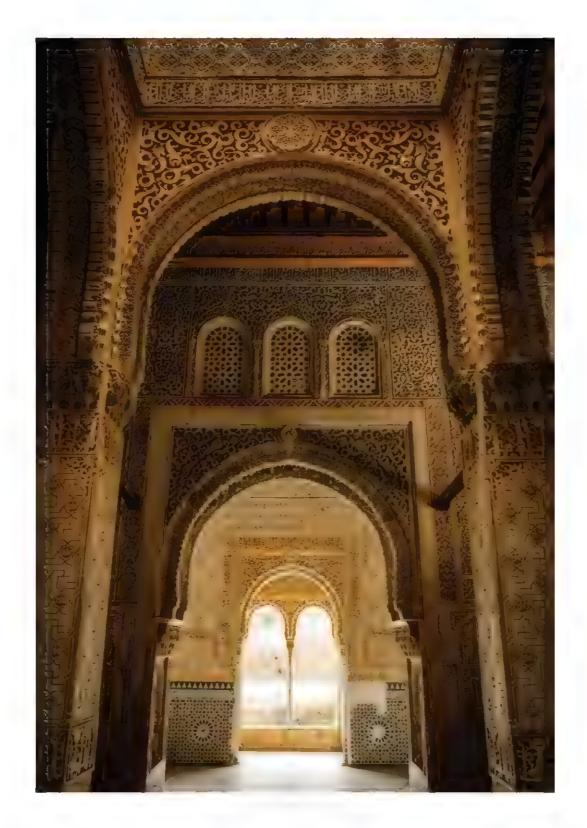
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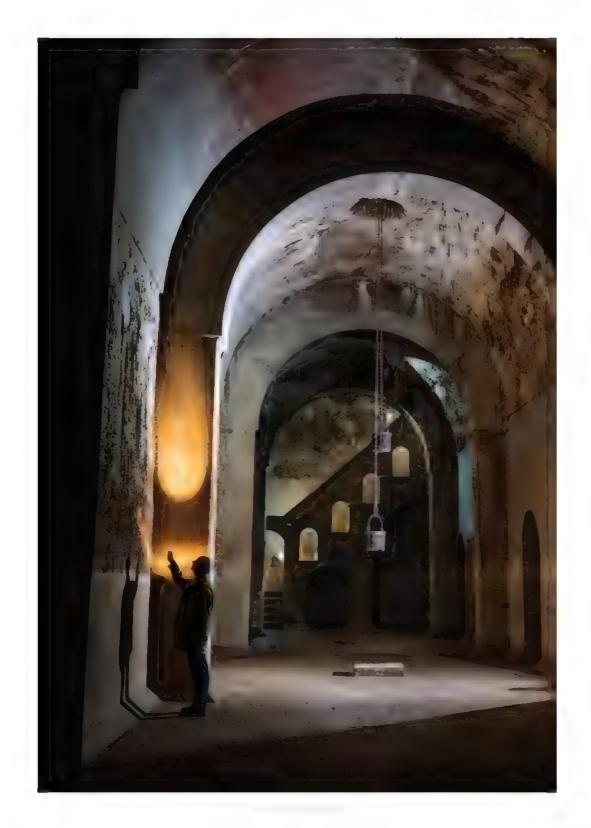


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Intimate spaces frame outdoor views. The defens ve Tower of the Captive (left), named for a sultan's legendary ove interest held there, was converted into a small palace. Its walls are adorned with Arabic inscriptions—a design element throughout the site describing the tower's beauty. Christ an rulers left their own imprint when they built chambers for a king. They enclosed a garden, creating the cloister-like Lindaraja Courtyard

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ARTICLE





JESÚS BERMÚDEZ has deep ties to the Alhambra. Born in the fortress built on an imposing hill in Granada, Spain, he grew up within the palace's walls. When his father became director of the Alhambra museum in mid-century, the family moved into a house inside the monument. It was "the stage," as he calls it, on which his days played out, an upbringing that steeped him in its legends and history from an early age-and inspired an enduring devotion to it. For nearly four decades, Bermúdez has been the archaeologist and conservator at the Alhambra, seen as the crowning glory of the nearly 800-year Muslim reign on the Iberian Peninsula. Though he moves through the complex with the easy familiarity of navigating one's own home, he still manages to impart a sense of wonder, as if glimpsing it for the first time. He stops often to greet student groups, guards, guides, gardeners. He displays the same pride I imagine the sultans must have had when they showed their palace to visitors.

Bermúdez is the ideal guide for a behind-thescenes tour (and has also written the official guide). Starting from the Gate of Justice, the largest of the Alhambra's four entry points, we explore not only its trademark courtyards and towers but also the recesses that few are allowed to see, places where fact intermingles with fable. As researchers continue to plumb its depths, the Alhambra remains a site for archaeology and restoration, including a rebirth of one of its most enigmatic works of art, recently completed after nearly 20 years.

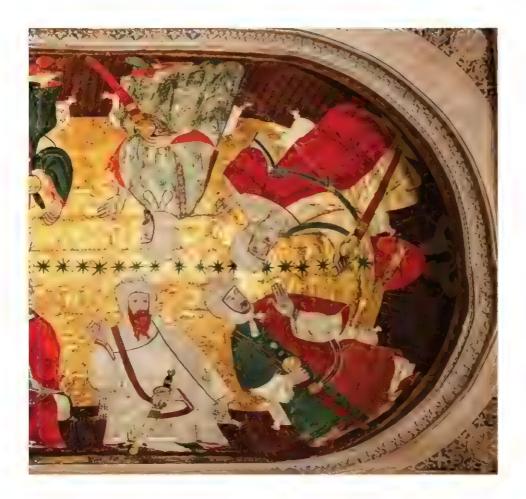
FORTRESS OF FA TH 93



In the Hall of the Kings, an enigmatic 14th-century painting newly restored—may depict Granada's sultans or a council of judges. Illustrated in vivid pigments drawn from apis lazuli, hematite, cinnabar, and gold, the scene's Gothic style is reminiscent of the work of artists in Italy and France.

"The Alhambra is first and foremost a palatine city," he says. "It was the seat of the head of state, with military barracks, a courtly city, and a set of palaces built over the course of two and a half centuries." The monument grew over that time from the primitive Alcazaba, or fortress, built by Muhammad I beginning in 1238, to later palaces reflecting the Nasrid dynasty's sumptuous style. A line of sultans from the Nasr family ruled until 1492, when this last stronghold of Muslim authority on the peninsula was toppled by a newly unified Spanish monarchy after the marriage of Isabelia of Castile and Ferdinand of Aragon.

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During the 254 years the Nasrids governed the Granada emirate, which extended far beyond the city itself, this part of today's Andalusia region was "frozen in time, maintaining a feudal society secluded in an idyllic oasis," Bermúdez explains. And yet the kingdom left a legacy in a monument considered the pinnacle of the beauty and architectural refinement born in Al Andalus, as the larger Muslim-ruled region was known. History could never forget it.

With Granada's fall, a succession of Catholic governors ran the fortress until the beginning of the 19th century, when it was occupied by Napoleon's troops. They decimated it on their

departure. The Spanish crown eventually ceded it to the state, and it became a national monument in 1870. Today the palatine city is alive again, with a court of officials at its service, a bureaucracy that keeps it running, and strict entry protocols, as if we're foreign envoys bearing a message for the emir.

ONE OF THE MOST NOTABLE envoys to Spain is the reason so many know this corner of the world today. The writer Washington Irving was a diplomat posted at the American Embassy in Madrid when he visited Granada in 1829. That was 17 years after Napoleon's troops had decamped,

FORTRESS OF FAITH 95

and what remained deteriorated from neglect. Rooms were plundered, the pools became washing areas, the courtyards were turned into corrals, and families who had nowhere else to go settled in the empty spaces. "It went from being a castle of kings to a refuge for outcasts, but it was always inhabited," says Bermúdez. "And that kept it standing." The squatters of the Alhambra, Bermúdez calls them.

Irving gave them a more romantic name: the children of the Alhambra. It was the vagrants, the bandits, the disinherited who, together with the ghosts of the defeated, populated his Tales of the Alhambra—unveiling the city and putting it on the tourist map. Still in every bookstore in the city and widely translated, the book perpetuated the fortress's romantic aura, reminiscent of One Thousand and One Nights. Other notables had set foot in Granada, but none had the impact of Irving. Given the weight of his influence, his single statue, set just off the Cuesta de Gomérez, a historic path to the fortress, seems a lukewarm tribute.

When Irving arrived at the Alhambra with his traveling companion, a Russian diplomat, they were appalled that visitors, even dignitaries, had left their mark in graffiti—their names and notes scrawled on its walls. The Russian provided a leatherbound guest book to discourage the practice. Thousands of signatures filled that volume for the next 43 years. It was an early glimmer of recognition of the structure's value.

Though his fellow traveler soon departed, Irving would stay on for several months, "spell-bound," he wrote, "in this old enchanted pile." He ensconced himself in royal chambers that opened up onto picturesque Lindaraja garden. Mateo Jiménez, a self-described "son of the Alhambra" who claimed his ancestors had lived in the fortress for generations, offered himself up as a servant and guide, recounting the family lore.

Places where Irving set his reflections and accounts still can be seen today, such as the reconstructed Gate of the Seven Floors. Popular legend holds that Boabdil, the last sultan, fled through that gate, imploring that it be sealed after his departure. Irving's story describes a succession of passages in which the sultan would have hidden a magnificent treasure in case he ever managed to return. Another spot, the Tower of the Princesses, later renamed after Irving's tale, was the setting for his story of three Muslim princesses who fall for Christian captives.

ONE MIGHT EXPECT A CHRISTIAN QUEEN TO REDUCE THE ALHAMBRA TO ASHES. INSTEAD, ISABELLA ORDERED IT TO BE LEFT UNTOUCHED.

The book made the fortress "an object of desire a need to visit it, to discover it," says Bermúdez. "Today we know this is also part of our heritage. Preserving a universal monument such as the Alhambra also means preserving all the values from its past."

THE ALHAMBRA HAS ALWAYS enraptured those from the outside. In January 1492 Queen Isabella, leading a military procession, began her triumphant ascent up Cuesta de Gomérez on horseback to Al Hamra, which translates to "the red" for the fortress's pink-hued stone. The Reconquest—lasting more than 700 years—had rolled back Muslim territories one by one across the peninsula. A papal order authorized this final crusade, resulting in a 10-year war waged for control of the holdout Granada kingdom.

When the keys to the Alhambra were finally surrendered, chroniclers noted Isabella's surprise as she took in the fine details inside the bastion that had long been forbidden to her: its intricate latticework, honeycombed vaulting, the infinite geometry of its tiles, trickling pools that mirrored the magnificent facades.

The Alhambra had been an impregnable fortress for almost three centuries. One might expect a Christian queen to reduce it to ashes, erasing from its walls the inscriptions prais ing Allah. Instead, she ordered that it be left untouched. What's more, she determined it would be her destiny for eternity, something that the unfortunate Boabdil could not fulfill: "I will and command that, if I should die outside the city of Granada, my entire body be taken, as it is, without delay, to the city." When she died in 1504 at her residence in the town of Medina del Campo, her coffin was sent on the three-week journey to Granada. The Alhambra, emptied of its Nasrid court just 12 years before, would be the final resting place of the Catholic queen. (Initially interred in the fortress, her remains, along with those of her husband, King Ferdinand, were later transferred to the Royal Chapel of Granada.)

While on his honeymoon several years later, King Charles V, Isabella's grandson, visited the city conquered by his grandparents. Grasping the symbolic value, he set out to designate his own palace in the Alhambra. Construction took more than a century, and the king never lived there, but Bermudez considers that beside the point. It superimposed a new narrative: Charles used the original architecture as a base to build anew, a metaphor for triumph. And "placing himself just that little bit higher," Bermúdez says. Standing adjacent to the three Nasrid palaces-the Mexuar, the Comares, and the Palace of the Lions, collectively the undisputed jewel in the crown for visitors the square, rigid structure built for the Spanish king was likened to "a meteor" by one architect.

Inside the central colonnade of Charles's palace, Bermúdez pulls out a key the size of his forearm and opens a door to a stone staircase. The "stairway of time," the Alhambra staff calls it. We descend in semidarkness to another gate. My eyes struggle to adjust before I'm dazzled by bright light. Bermúdez wields a new key and, as if enchanted, I'm suddenly standing in the Courtyard of the Myrtles, named for the bushes that surround its rectangular pool, in the Comares Palace. Yes, a bit lower than Charles's.

In a moment we transitioned from Renaissance sobriety to a saturation of the senses, from the victors to the vanquished. The staircase, built in 1580, was intended to do precisely that: to unite the old royal house with the new one.

Tourists view our sudden apparition as if we were ghosts from the past. With a mischievous smile, Bermúdez closes the door behind us.

some two million people visit the Alhambra each year, but they're limited to about 20 percent of the site. Bermúdez guides me through some of the hidden parts, namely an underground network. These are modest and functional rooms, he says, kept out of sight as they were back then, the domain of servants and guards who kept the palace running. Some also held prisoners. We peer into one of the complex's 20 dungeons, which was discovered just over a century ago. After the fall of Granada, the queen herself rushed to free Christian prisoners, as she had done in the Muslim stronghold of Málaga, where an officer from the Netherlands told her he'd been held for more than 40 years.

Still in the bowels, we make our way to a large cistern, which more readily resembles a cathedral with its barrel-vaulted naves and sheer size. The underground structures also provided a cool, stable temperature to store grain and other staples. As we descend by ladder into a cavelike silo, it strikes me as the place where the Alhambra's legendary passageways could begin. I instinctively search with my headlamp. None are here, but they do exist. One level up, members of the royal guard would have been posted beneath the throne room in the Comares Tower, ready to intervene in a crisis. We walk through the tunnels, aware that tourists marveling at the magnificence of the room cannot imagine the infrastructure that lay beneath.

Bermúdez unlocks a door. A flashlight illuminates a staircase that leads deep into the earth and, after 200 steps down, to yet another door. It opens into the heart of the woods, just outside the walls. We're a short distance from the Darro River. It would have been an easy—and clandestine—way to leave the fortress. In 1359 Muhammad V, the eighth Nasrid monarch, was ousted by a revolt that put his half brother in his place. In the middle of the night, rebels scaled the walls and knifed the guards. Barely 20 years old, the rightful sultan escaped—some say through a passageway in the Comares Tower. Was this the place where he would have arrived breathless and been spirited away?

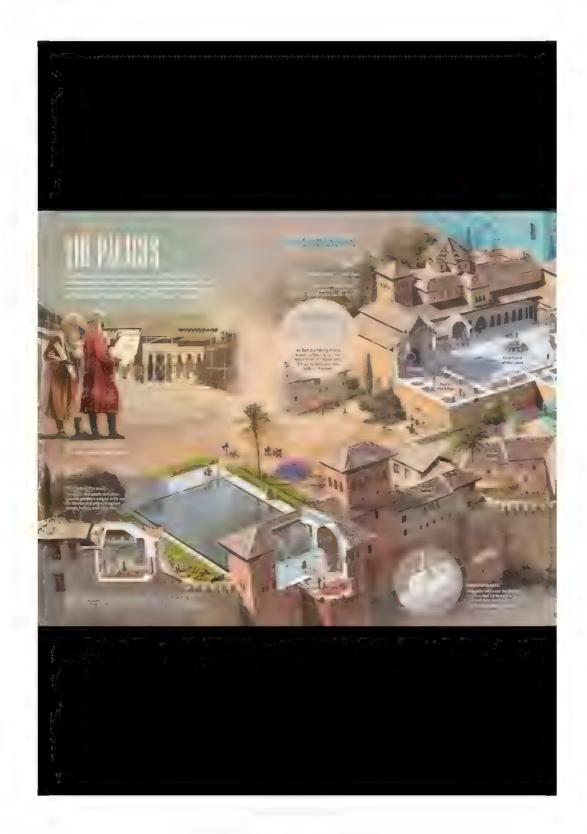
The coup was a game of thrones involving changing loyalties, including that of his Christian ally Peter of Castile. After three



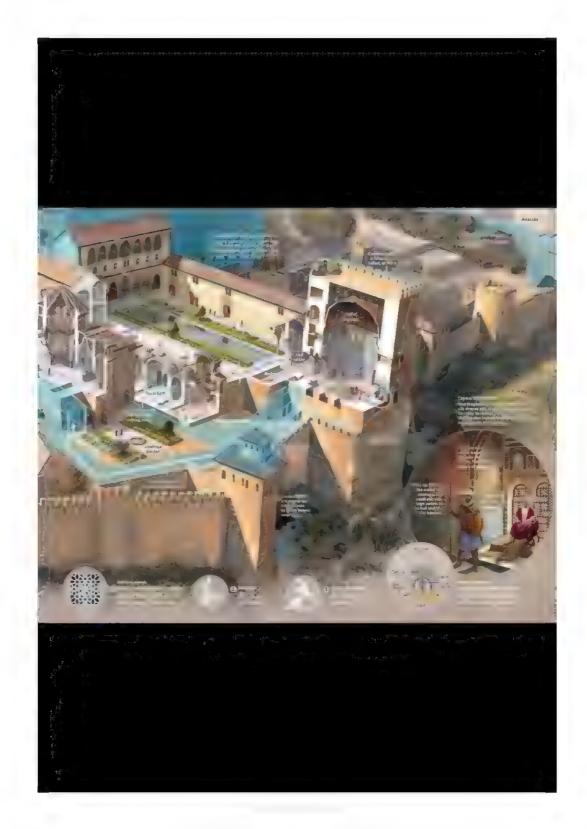
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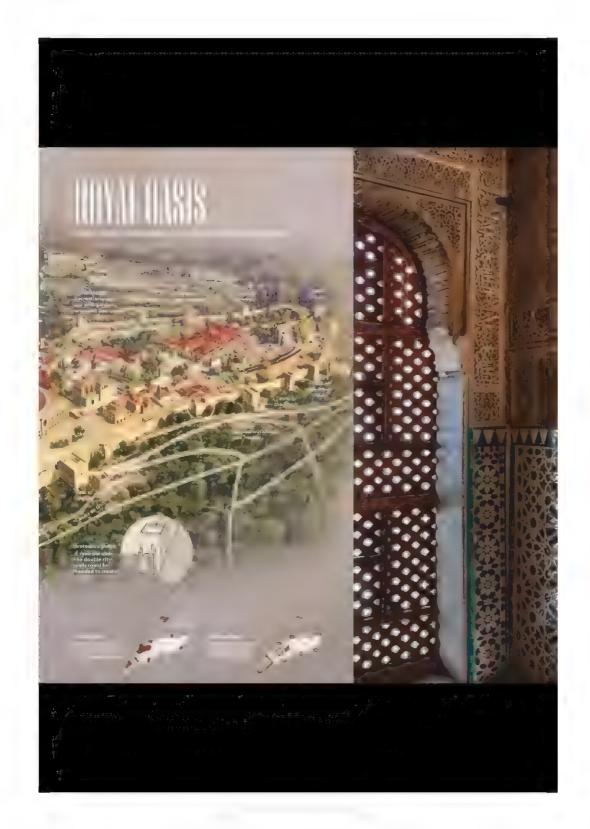
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2 ARTICLES



years, Muhammad V returned to his throne. Without that subsequent prosperous and peaceful 30-year reign, the Alhambra as we know it today would not exist. Muhammad ushered in the dynasty's golden age. He built what many consider to be the most striking spot in the Alhambra—the courtyard with a central fountain ringed by a dozen lion statues—and he continued his father's tradition of embellishing palaces with another art form: Arabic inscriptions.

THE ALHAMBRA IS A PALACE OF POEMS, an architecture of words, says José Miguel Puerta Vilchez, author of Reading the Alhambra, which decodes the inscriptions on its walls. Like Bermúdez, he's spent his life studying this place and translating it to the world. "If it lost its supports, columns, and arcades, the building would be held up by words alone," he says, referring to its ubiquitous calligraphic panels. Leaning on his knowledge, I see a different Alhambra-with the language barrier, one that remains largely inaccessible to those who inherited it. Verses run along its walls, curl in cartouches, and even meet in the closets. Some are carved in plaster, others in wood, or meticulously inscribed on tiles. The

THE ONE WITH
THE BEST COMMAND
OF LANGUAGE
BECAME THE MOST
POWERFUL IN
THE KINGDOM AFTER
THE SULTAN.

omnipresent motto of the Nasrid house, "There is no conqueror but God," alternates on the walls with greetings for visitors, including baraka (blessing), afiya baqiya (perpetual health), and yunn (fortune).

In reality, the Alhambra was designed to praise God-and the sultan, as God's earthly representative. The ornamental script envelops visitors as if they were inside a monumental book. But the power of the written word didn't end there. The Diwan al Insa, the office of correspondence and records, was created around 1273 and run by a master of two nuanced arts: diplomacy and writing. "His function was propagandistic," says Puerta Vílchez. "The texts had to be not only correct but beautiful, poetic, capable of praising God, the dynasty, and the sultan." The person with the best command of language, the katib, became a double vizier—head of that office and prime minister the most powerful man in the kingdom after the sultan.

Puerta Vílchez regards the kingdom's great poets as if he had worked with them himself. composing verses or transcribing internal documents that serve as invaluable chronicles of a tempestuous era. In his view, it's the swan song of the dynasty, aware of its geographic isolation on the peninsula and the inevitability of its fall. Written mainly by three successive poets who headed the chancellery in the 14th century, the Alhambra's epigraphs represent some of the Nasrids' most dazzling contributions to Islamic art-perhaps an attempt to demonstrate a grandeur that was not going to last much longer. Of the two forms of Arabic used, the naskhi, or cursive, is easily visible, but the Kufic form may go unnoticed even by a visitor who knows the language. With a rectilinear style, it can masquerade as a geometric element, blending into the decor.

In the Palace of the Lions, poet Ibn Zamrak and Muhammad might have had their boldest collaboration. Its fountain, magnificently sculpted so that the rock grain simulates the lions' muscles, contains a symbolic message. It features the word "caliph," Islam's highest leader, whose role transcends that of sultan. The change in title imbued Muhammad, a political figure, with religious authority—an impeccable example of 14th-century PR. "Those were difficult times," says Puerta Vilchez. "The sultan needed to legitimize his power not to Christians so much as his own people."

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THE SAME PALACE ALSO HOLDS a rare artwork in the Hall of the Kings, which after a two-decade effort has just been restored to its former glory. Three painted scenes include human figures, atypical in Islamic art. But that's not the only enigma. Presiding over the central dome, 10 men dressed in luxurious Muslim-style garb appear to be watching over the space. One theory maintains they're the first 10 Nasrid rulers (hence the room's name). Two other paintings depict medieval court vignettes in which Christian and Muslim knights hunt, joust, and rescue maidens. (Muslims always win in these scenarios.) "At least two royal weddings took place in the Hall of the Kings," says Puerta Vílchez. "These paintings extolled the splendor of the Nasrid court and were meant to be seen." The 14th-century works were eventually hidden when the room was absorbed into a 16th-century church. Over time, they deteriorated.

The original canvases were made from horsebide tanned with alum and embellished with natural tempera pigments, then attached to wooden frames shaped like inverted boat hulls and covered with tar and plaster to prevent water or fire damage. "Artisans from different trades were involved—specialists in wood, painting, and leather. Together they created a masterpiece whose execution technique is unknown in the Spanish-Muslim world," says Elena Correa, who heads the Alhambra's restoration department.

A collection of architects, master plasterers, carpenters, and painters has worked hand in hand to repair the hall, presumably as the team that created this artistic jewel did 600 years ago. One achievement was inventing a restorative mortar that's imperceptible to the viewer. The stealth ingredient is quinine. "If we want to show a reconstructed segment, we have to use ultraviolet light," says Ramón Rubio, who leads the stucco and tile restoration workshop. The inspiration arose from an unexpected moment—when he observed quinine's fluorescence in a gin and tonic under disco lights.

Who were the painters of these scenes showing a last vestige of coexistence between Muslims and Christians before the fall of Granada? Experts say they could have been Christian artisans from neighboring kingdoms that commercially traded with the emirate—mainly those on the Italian Peninsula and particularly Genoa—or Muslims who knew the Renaissance techniques of those

Some 500 people care for the historic site, including 40 gardeners and more than a dozen highly specialized technicians for ongoing restoration. Here custod ans attend to an arcade in the Generalife, whose name originates from the Arabic Jannat al Arif, or Garden of the Architect. Located uphill from the Alhambra, the palace was the sultan's private family retreat

JUAN MANUEL CASTRO HEEFC AGENCE VII. REDUX

courts. Despite the arduous research involved in the restoration, in this place, as in so many others in the Alhambra, mysteries remain.

I LOOK OVER TO THE ALBAICÍN, Granada's labyrinthine medieval quarter, built on a hill opposite the Alhambra. With its whitewashed facades, villas, and hidden gardens of cypress trees, it's hard to imagine a more perfect view. I descend toward the Albaicín down a lane known as Cuesta del Rey Chico (Little King, Boabdil's nickname), departing as the 24th and last Nasrid sultan did when he left the fortress forever. Crossing



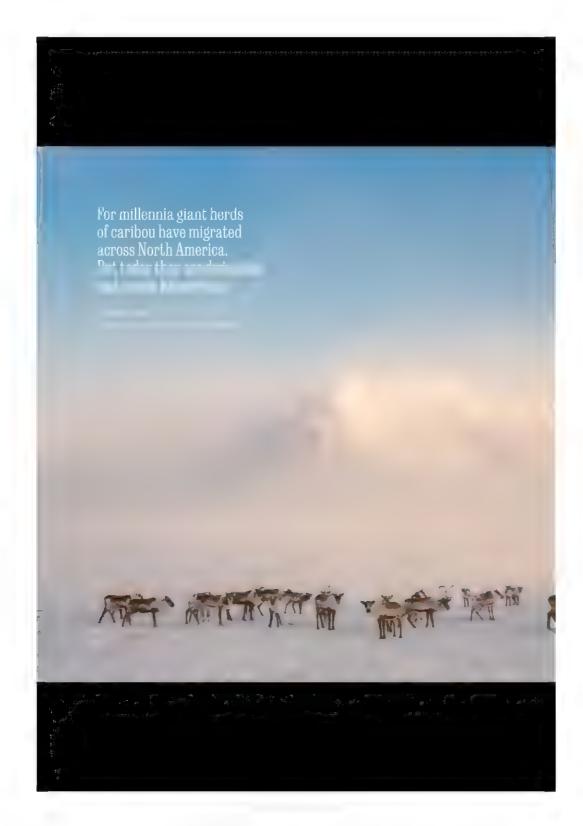
into that parallel world, I see the Alhambra as his subjects might have. From the Albaicín, the Alhambra's palaces can be read chronologically from right to left—like Arabic itself. The language can still be heard in the quarter, which is lined with tea shops and has the ambience of a souk. After Boabdil was deposed, residents were allowed to keep their businesses, homes, language, and religion, but that spirit of coexistence lasted only eight years. By 1501, Muslims were forced to flee or convert to Christianity.

I peer into the Dar al Horra Palace, the home of Boabdil's mother and his final refuge in

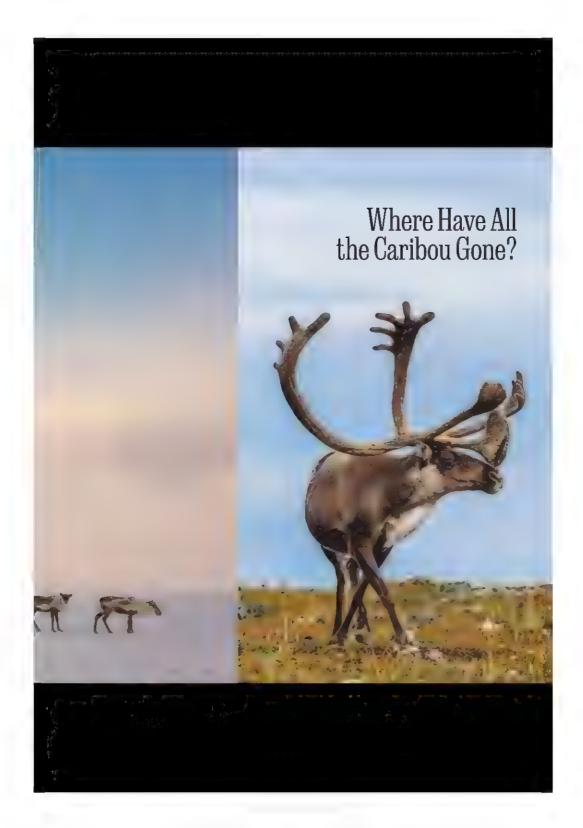
Granada, before he fled to Morocco. Nothing on the outside gives away its graceful interior. Like the Alhambra, the exterior reveals little. Beauty is unveiled only within. Before leaving, I pause for one last look. My friend Blanca Rooney, a veteran guide, is beside me. "I've seen it many times," she says. "It's the look of someone who is bidding farewell to the Alhambra as if they had just been expelled from it." □

Staff artist **Fernando G. Baptista** is from Bilbao, Spain, and previously illustrated Barcelona's Sagrada Familia. Other story elements were adapted from the magazine's Spain edition.

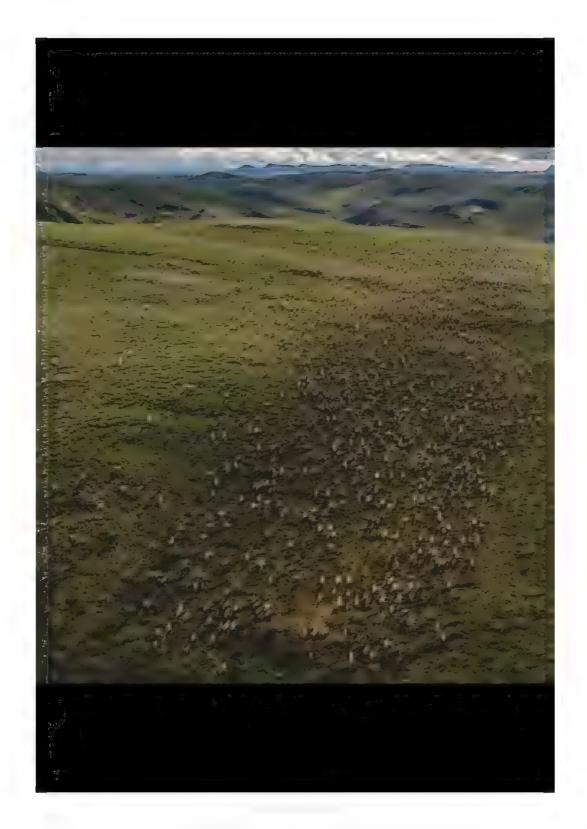
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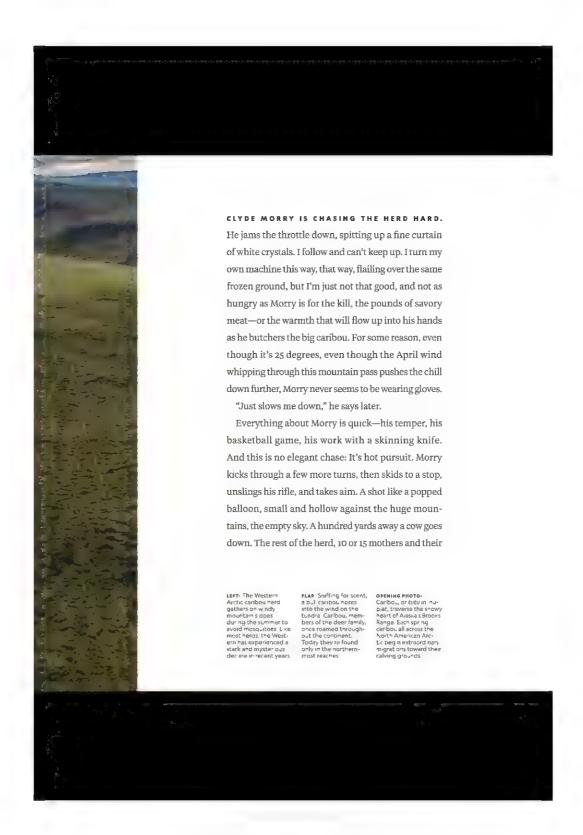
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calves, keep running but not too far, as though they know the worst is over.

Morry and I drive up to the cow and see his shot has been clean. He slips out a knife from his black coveralls, bends over the body, gets to work. First, he severs her head. His people, the Nunamiut of Anaktuvuk Pass, Alaska, believe this and what follows are the most important steps. He carries the head a little distance away, gently, as though he were carrying a favorite cat, and places it just as gently in the snow, upside down. The cow's inua, her soul, may now escape and fly to the spirit world. There, a guardian

spirit will comfort the cow's soul and then send her to Earth again in a new body.

This is the cycle of respect and return and renewal. Morry is 37, and it's what he knows, what he was taught, and what he teaches his children. After the head is set, Morry begins butchering. Quick sharp strokes. Slick red hands. When his fingers get cold, he shakes them and blows on them and places them against the body to soak up some of its fading heat. When the meat is finally stacked onto a sled, he says, "Maybe I'll put on some gloves for the drive home."

He does, and drives back to Anaktuvuk Pass at



Tlicho Nation members Joe Zoe (rignt), Janet Rabesca (left), and Tyanna Stennwand look for the Bathurst herd in a remote corner of Canada's Northwest Territories. The Tlicho have relied on Bathurst caribou for generations, but since 2015, with the herd's numbers spiralling, hunting them has been banned.

a much safer speed. This is not to say he drives slowly—he is mindful not to let the meat freeze. But this time I manage to keep up. Even, once, to pass him. As I do, I notice he's grinning. Morry has no job but this; he wants no job but this. Hunting is how he provides for his big extended family. And tonight at home there will be plenty of food and plenty of people gathering to eat it.

Morry's father will ask me, "Did you see him turn the head over?"

"Yes," I'll say.

The elder will nod. "Don't forget."

THE CARIBOU COW CLYDE MORRY KILLED

belonged to the Western Arctic herd, sometimes simply called the Western. At the time, in early 2021, the Western was one of Alaska's largest groups of caribou. In the 1990s, when Morry was learning to hunt, the Western was on its way to a high of nearly 500,000 animals, and they roamed a territory about the size of California. Many of them walked right past Morry's house twice each year during their spring and autumn migrations, providing his community with a steady source of food and spiritual well being in a roadless and extremely remote part of northern Alaska.

But by 2021, the Western's numbers had dropped by more than half. Some years, Morry and other hunters told me, very few caribou trickled through Anaktuvuk Pass. In other years, they arrived weeks late or didn't come at all. None of this was necessarily unusual—canbou herds have been known to fluctuate in size over time, and they are wild beings, heeding their own instincts, schedules, and motivations. Placed into a larger context, though, the decline is deeply unsettling because the Western is not alone.

Migratory tundra caribou can be called many things: barren-ground caribou or eastern migratory caribou in Canada, while in Alaska "caribou" alone will usually do. In Russia and Norway, nearly identical animals are called wild reindeer. All of these live in extreme northern habitats between the tree line and the remote reaches of the Arctic tundra, and they make long migrations. No matter where you look or what you call them, they have been fading away for decades right before our eyes.

Between the late 1990s and 2018 these animals declined by some 56 percent, from about five million to two million. After 2018, data on Russian reindeer (as well as collaboration with Russian scientists) were harder to come by, but in North

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Caribou on the Move

Dozens of tundra caribou herds have long roamed across the upper reaches of North America. Some of these herds make the lengthiest migratory circuit of any land mammal—more than 800 miles when measured in a straight line. But recently, caribou numbers have declined dramatically, for reasons scientists are trying to unravel.

North American migratory tundra caribou (Rangifer tarandus)

Subspecies ranges

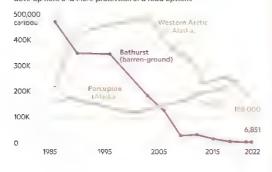
Alaska R t. granti

Barren-ground R.t groenlandicus Eastern migratory R.t. caribou



Plummeting populations

Western Arct c and Bathurst numbers, 15 percent of all m gratory fundra caribou today, have been falling for decades. The Porcupine herd has seemed stable; its habitat has less mining development and more protection and food options



Bathurst seasonal journey

The nerd is increasingly disrupted by development, such as mining roads. A warming climate also has impacts: more violent storms and insects, and more species moving north earlier in the year, including predators.

Winter/ice road

Road

* Mine

Tral Ben M.

Setting off in spring
From April to June the

herd in grates north to calve where forage is rich and mosquitoes are not yet active Winter range

Stewards of the herd

Nomadic ancestors of the Tilicho Nation fol owed caribou. In 2015 the Tilicho ha ted their hunting to focus solely on conservation

Horn Platead

Fort Simpson

Jean Marie River



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LEFT: Nunamijt hunter Daniel Morry holds the still-warm heart of a caribou shot near his home in northern Alaska. Keeping with tradition, Morry will d stribute the meat in his community, starting with the elders. TOP: A skeleton picked clean by predators marks the route the Western Arctic herd takes through the Brooks Range at Anaktuvuk Pass, which in Inupiat means "the place of many caribou droppings"

ABOVE: Clyde Morry, Danie 's uncle, prepares to haul a k II home with his snowmobile. H's grandparents were part of the last Nunamiut who followed car bou, until about 1950, when they settled in this area. America the fall continued. Of about 13 major herds in Canada and Alaska, most have suffered steady losses, and at least one, called the Bathurst, has disintegrated to the point where it may disappear completely within a couple of years.

There's no consensus on what's behind this great vanishing. No disease has been pinpointed, no individual culprit gets the blame. No remedies or policies seem able to stop or even slow it. To anyone who lives south of the Arctic Circle the problem can seem abstract—another distant note of sadness in an era heavy with extinctions. But this is not how it appears in the far north.

In small communities scattered along the tree line or set in the open tundra, towns such as Anaktuvuk Pass that are often isolated, often Indigenous, where imported food and gas can be astronomically expensive and hunting caribou is often the cheapest and fastest and certainly the most satisfying way to provide for a family, the decline brings a peculiar dread. An Inupiat elder in a coastal town told me it was like feeling the symptoms of a cold coming on. The cold arrives, and it lingers. You don't get over it. Then it worsens, until you become gaunt and haunted, until you're afraid it isn't a cold at all but something deeper. Something that's shot through your whole system.

This is how the caribou problem feels to many Native people in the north, including the Nunamiut. Their name means "people of the land," but anyone will tell you that they are, most of all, a caribou people. They are also sometimes called America's last nomads, because only in about 1950 did the Nunamiut give up a mobile life, a life spent hunting and following caribou. They chose to settle in Anaktuvuk Pass exactly because the herd poured through it like a river. The name Anaktuvuk means "the place of many caribou droppings."

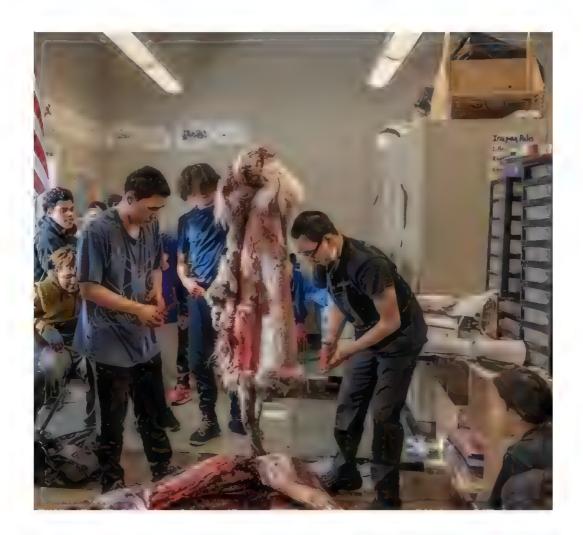
One night after I'd gone out hunting with Clyde Morry, his father, Mark, made a quiet comment about the choice his people had made. Mark Morry was a veteran of the Vietnam War. Thick gray hair, thick old glasses. He sat in a recliner by a window in the house he had built, watching his family eat caribou that Clyde had brought home.

"It was a big gamble for them to settle down like that," Mark said of his own father and mother and uncles and aunts, the generation who gave up nomadism. "They figured the caribou would always be here."



Nunamiut elder Ray mond Paneak (seated left) teaches pupils to butcher a 400-pound caribou and process its hide at Anaktu-vuk Pass's school. The class is part of a community effort to pass traditional skills on to younger generations. Paneak d ed several months later, at age 81.

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WHEN WILDLIFE BIOLOGIST HEATHER JOHNSON

arrived in Alaska several years ago, she was surprised to discover how mysterious caribou still were. Like other northern creatures—polar bears, say, or narwhals—caribou live what writer Barry Lopez once called obscure lives. They can be hard to find. Expensive to study. They spook easily. Even what they eat has been, at times, difficult to pin down. This is a major reason their decline is so puzzling.

"I didn't think there was a terrestrial large mammal left in North America that we didn't know much about," said Johnson, who works for

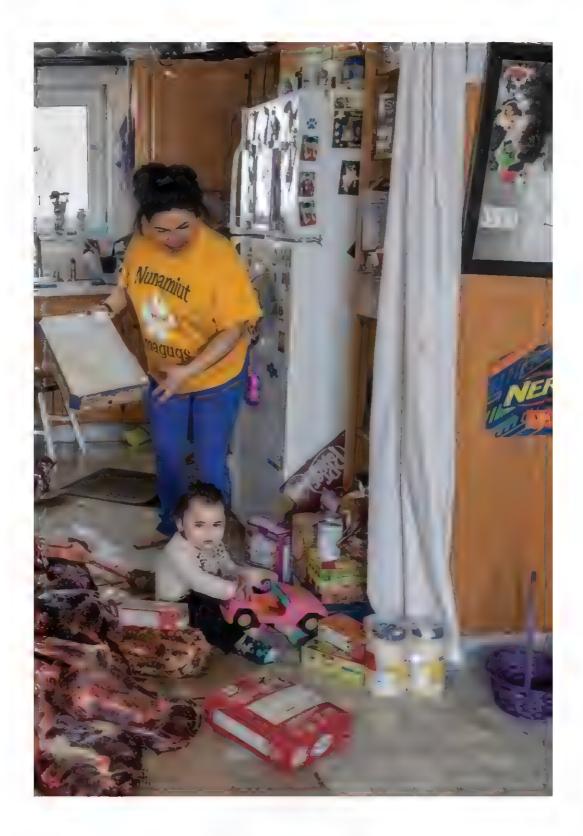
the U.S. Geological Survey. "I thought, how can we possibly know so little about these animals? But then an older colleague said, 'Heather, you've got to flip that around: You should be impressed that we know even as much as we do.'"

Consider, for example, that only recently did researchers confirm that caribou are among the planet's greatest wanderers. Using data from satellite tracking collars, a team led by Kyle Joly, a wildlife biologist with the National Park Service, showed in 2019 that the animals can travel more than 800 miles each year—in point-to-point, straight-line terms—on their migratory circuit.

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That's farther than all other terrestrial mammals.

During these epic journeys caribou may navigate between dark spruce forests and sunbleached tundra, or from bleak mountainsides to wind-blasted coastal plains. They've even been known to walk into the sea. They also face an array of natural hazards—wolves, bears, icechoked rivers, galactic swarms of mosquitoes, and life-draining parasitic flies—as well as an ever increasing set of human made obstacles: oil fields, roads, and mines.

Climate change, too, is rapidly transforming their habitat. Rising temperatures across the Arctic now routinely disrupt familiar weather patterns. Where snowstorms were once the signature weather event of an Arctic winter, freezing rain is becoming more common, locking caribou forage away under impenetrable lids of ice. Summers are also growing longer, which isn't necessarily a good thing: Warmer temperatures bring new plants and animals, more parasites, and even wildfires to the tundra.

All these forces affect caribou in ways we've only begun to unravel. What it means is that if you're a scientist, a hunter, a conservationist, or anyone who comes looking for a reason for the vanishing, you'll suddenly find yourself staring into a problem as big as the landscape itself.

"I THINK BY NOW IF THERE WAS JUST ONE THING, we'd know it," said Jan Adamczewski, a Canadian biologist. "But when you draw up a list of all the things that might be affecting caribou, it can be a very long list. And when you draw up a list of things you can do about it, it's usually a very short list."

Adamczewski works for the government of the Northwest Territories, which is home for at least part of the year to seven migratory tundra caribou herds. This includes the Bathurst—the one that has come to represent a kind of worst-case wild-life scenario. In 1986 the herd numbered 472,000 animals. From there it began a gradual decline that eventually tumbled toward collapse. By 2021, the herd had dropped 99 percent.

The fall was extraordinary, and when I asked Adamczewski what might be behind it, he sighed. He was used to the question—often posed by people who'd already arrived at their own conclusions. Adamczewski told me that many people he spoke to believe climate change had something to do with the herd's decline. But the term was vague, the effects hard to parse.

It was a lot easier, Adamczewski said, to zero in on smaller, more discrete suspects. Wolves were a popular villain. Other people believed hunters were killing too many animals. And within the Indigenous communities that make up nearly half the territory's population—and that stand to be most affected by caribou loss—mining was often seen as the greatest threat to the herds, Adamczewski said.

Around the time the Bathurst seemed healthiest, a handful of mines opened in the Northwest Territories, including Colomac, a gold mine, and Diavik and Ekati, both diamond mines. All of them sprawled across the home range of the Bathurst, and Lupin, an older gold mine, lay due south of their calving grounds in Nunavut.

"Everyone around here knows that the Bathurst were at their peak [then]. And then the mines came and roads were built, and the caribou started to decline." For many people, Adamczewski said, it was no coincidence.

Several studies have shown that industrial development disrupts caribou behavior. The animals often seem to perceive roads and pipelines in particular as obstacles blocking their migratory paths and feeding patterns. They also tend to avoid mining camps and oil fields, which can leak chemical odors and tailings, shake the earth with drilling equipment and truck traffic, and fill the air with the racket of planes and helicopters.

While mining in the Northwest Territories will almost certainly carry on no matter what happens to the Bathurst (the territory is heavily dependent on the industry, which provides thousands of jobs and millions of dollars in revenue), Adamczewski said the territory and several First Nations had attempted other approaches to halt the Bathurst's hemorrhaging. In 2015, he said, the territory established a controversial hunting ban, which was supported by local Indigenous communities. The territory has also tried to reduce wolf numbers by, among other things, shooting them from aircraft. Still the herd shrank.

ONE OF THE MOST HAUNTING CONSEQUENCES

of decline, for the Bathurst itself, appears to be an increasing loss of identity. In caribou biology, the term "herd" usually refers to a group of animals that all return to the same place to give birth the same calving grounds. Mothers teach their young how to navigate there, show them different feeding spots along the way. They also share

Caribou live obscure lives. They can be hard to find. Expensive to study. They spook easily.

alternative routes, detours that might be useful depending on what the weather or the wolves or the human hunters are doing.

I've long thought these migrations resembled pilgrimages. The education of younger animals (delivered mostly by older females) is connected to what scientists often call the herd's collective memory: its unique and enduring way of knowing the landscape. Some have even begun to call such practices culture. These cultures are cohesive enough that the animals tend to stick with their own and remain loyal to their calving grounds.

But Adamczewski said that in recent winters the Bathurst had been mixing with another, much larger, herd called the Beverly. Maybe the Bathurst caribou were seeking safety in the Beverly's numbers. Maybe they would fold into the larger herd. It was still possible for them to recover; other herds had come close to disappearing and scraped by. But the Bathurst's singular culture-its way of being, as an Indigenous friend had put it to me was at risk of blinking out.

"If we lose one of these herds, there's a lot in terms of behavioral memory that we also lose," Adamczewski told me. "When caribou don't visit their traditional calving grounds, they don't seem to live as long.

Seen against other changes unfolding in the far north-greening tundra, melting sea ice, burning forests-the unraveling of the Bathurst appeared like a symptom of dementia, the landscape losing another piece of its identity. Would the Bathurst's condition spread? Was it irreversible? Was there a cure? No one knew.

Adamczewski said he found hope in small details: signs of growth in one herd, say, or a slowing rate of decline in another. Even holding on to a broader sense of time itself helped.

Caribou herds seem to follow cycles, he said,

phases of boom-and-bust during which they peak and then contract. Across Alaska and Canada, many herds, including the Western, bottomed out in the 1970s and then began to climb into the '90s and early 2000s. Indigenous oral histories record even earlier eras of plenty and of dearth.

If cycles do exist, their causes are unknown and appear to operate on decades-long intervals. The idea is attractive because it suggests caribou herds naturally bounce back. But it can also be misleading, many researchers warned me, because in a rapidly changing, warming world even the most durable creatures may not have enough time to recover.

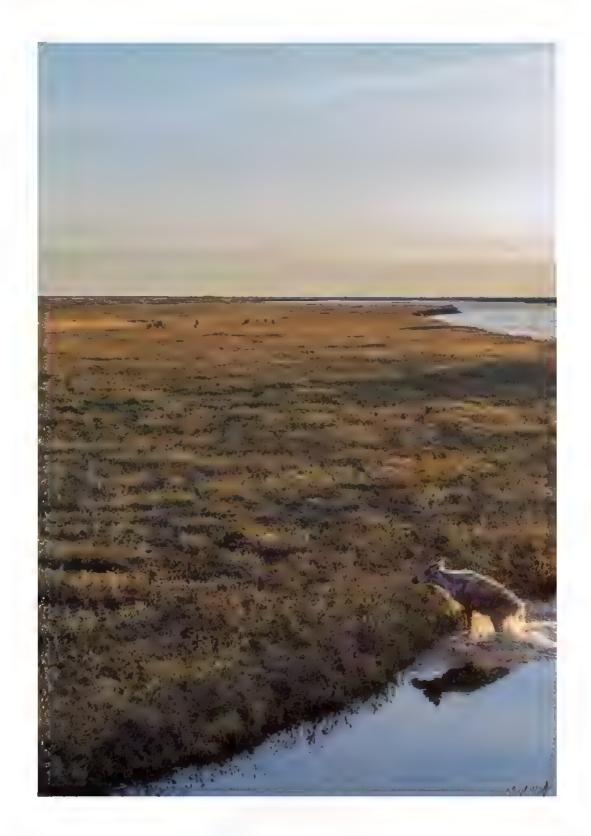
"There are times when we do lose herds on the landscape, and there are times when new herds will be forming as well," Adamczewski told me. "Herds are not immortal. They're not fixed forever in time and space."

ON AN OVERCAST DAY IN AUGUST 2021 I STOOD

on a green tundra plain in an isolated corner of Nunavut, looking over dozens of caribou trails. They were deep and narrow, and they scored the earth in every direction, like rows of corn, like rays of light in a child's drawing of the sun. You could pick any of them and walk it to the horizon. Maybe all the way back to the city of Yellowknife, 250 miles to the south.

I chose a trail and followed, clumsily, slotting one boot in front of the other. Beside me a stout, athletic man named Roy Judas did the same. He wore woodland camouflage, though the nearest tree was more than a day's walk away. And he carried an old lever-action Winchester rifle, in case of bears, or "big men," as his people, the Tlicho, sometimes call them a term of respect. On that day, though, the big men were absent, off hunting or munching cloudberries somewhere else.

Everywhere we turned, the tundra appeared



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empty. We were near the calving grounds of the Bathurst; the old trails were probably theirs. But the caribou were absent too.

While I walked, I tried to imagine the volume of animals required to shape the landscape this way—to impress their passage so firmly. Tens of thousands of caribou. Decades of migrations. The earth thrumming under their spadelike hooves.

"Used to be a highway for them," Judas said. "All gone now."

Like Clyde Morry in Anaktuvuk Pass, Judas had grown up hunting caribou in the forests near his home in Wekweeti. His mental maps of the landscape, as well as his people's language and culture, were flecked with caribou related landmarks, stories, vocabulary. Skins from Bathurst caribou had once been their most valued resource. In the form of tents, equipment, and clothing, they made human life possible along the cold frontier where the great northern forests faded into open Arctic tundra. Some Tlicho told me they could even taste the difference between Bathurst caribou and animals from other herds.

Judas could no longer hunt the Bathurst, of course: The Tlicho, a First Nation, had abided by the territorial hunting ban. But this decision, he and others told me, had not been easy. By that time the Tlicho (sounds similar to CLEE-cho) had already suffered from decades of colonial practices, including language and cultural loss. The collapse of the Bathurst only deepened a sense of existential crisis. If the Tlicho couldn't hunt the Bathurst, if they couldn't maintain traditions and ancient bonds with the animals, who would they themselves become?

The Tlicho were still wrestling with the question when I joined Judas and several other Tlicho citizens on the shore of Koketi, also called Contwoyto Lake. One of the nation's answers had been to create a program called Ekwo Naxoehdee Ke, which means, roughly, "following in the trails of the caribou." (It's also known as Boots on the Ground.) For part of each year Judas worked for the program, leading groups of Tlicho citizens to Koketi, where they spent weeks camping, hiking, and searching for remnants of the herd.

"When we find them, we take notes," Judas said. "We watch them, we follow them. We try to get close and figure out what they're up to."

The observers counted caribou and recorded other details, including how they looked, where they were traveling, what they were eating, and



Southern mountain caribou browse for lichen in an enclosure in south central British Columbia. A consortium of First Nations captures and collars pregnant females to help restore the imperiled subpopulation.

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who was eating them. At the end of every summer, the results were returned to the Tlicho government, which used them to guide management decisions for the Bathurst.

"The main reason for creating that program was for our own Thcho people to be the eyes and ears of what's happening out there with the caribou," said Tammy Steinwand-Deschambeault, director of the department of culture and lands protection for the Tlicho government. "The elders didn't want to rely on the territorial government or anybody else to say, 'This is what's happening; this is what we're seeing.' The elders

said, 'We need to see for ourselves. So let's get out there.' $\sp{"}$

Steinwand-Deschambeault told me the Boots program also had secondary goals: to expose younger Tlicho to language and hunting skills (if not hunting itself) and to keep contact with the Bathurst.

"If we're not on the land, the caribou think that they're not needed," she said, and they might decide to go away. "So we need to go back to being out on the land more, you know—attend to these kinds of relationships. We have to do our part."

WHERE HAVE ALL THE CARIBOL GONE? 133

DURING THE TIME I SPENT WITH JUDAS AND HIS

crew, we saw many animals. Enormous bears, trout as long as my leg, eagles, cranes, muskoxen, and a young white wolf that walked through our camp as though she owned the place.

We also passed through layers of deep human residence. Century-old campsites, hunting blinds built of stacked boulders that dated back to an era of arrows and spears. Often, when we paused to rest, we found our feet surrounded by "lithic scatter"—shards of stone left by hunters who'd long ago sat in the same spots, knapping tools from flint or quartz.

But there were very few Bathurst caribou. At the time, only about 6,000 animals were believed to remain. That number seemed large, at first. With a little effort, I thought, we couldn't help but find the herd. Judas gently corrected me. It would be easy, he said, for so few animals to disappear into the belly of the tundra. As the days dragged on without many sightings, I began to grasp the scale of the problem.

I live in New York City. The closest wild migratory tundra caribou roam some 1,000 miles away in Ontario. Even for me, after years spent work ing on this piece, interviewing dozens of people and camping many nights in caribou country, the animals are usually out of sight, out of mind. Less like a fellow being and more a distant idea, a shadow drifting over the map. Multiply this conceptual distance across most of our lives, and you see why their fate doesn't summon a sense of alarm in the capitals of Ottawa or Washington.

For Roy Judas the response was clear, and it was personal. In summer, he counted caribou on the tundra. In winter, when the Bathurst migrated back into the trees near his hometown, he worked for the territorial government helping to enforce the no-hunting rule. It was his way of respecting the animals. Of tending to the old relationship. And for a while it made him unpopular.

Back in 2015, when the ban took effect, not everyone had supported it. Some Tlicho resented the notion that outsiders were trying to control their herd. They wanted to keep hunting, as they always had, and occasionally Judas's job forced him into uncomfortable conflict with neighbors. Once, he'd even caught an old friend hunting.

Late one evening on the tundra, as we tripped through caribou trails, Judas told me that people seemed finally to be coming around to his way of seeing things.

"What way is that?" I asked.

He swatted a mosquito, hefted his rifle to the other shoulder. "I want there to be caribou in the future," he said.

HEAD WEST FROM THE LAND OF THE BATHURST,

across the Northwest Territories and into the Yukon, toward Alaska, and you will find the outlier in this story. Here, touching the coast of the Beaufort Sea, straddling the international border, and reaching into the lands of the Inupiat and Gwich'in, lies the range of the Porcupine herd.

When I began this project, nearly every researcher I spoke with was quick to point me toward them. The Porcupine, they said, seemed to be bucking the continental trend. And it wasn't that the herd had simply failed to collapse: Their numbers had recently increased.

Between 2013 and 2017, when the Bathurst were steadily shrinking and the Western soon would be, the Porcupine grew by about 21,000 animals to reach 218,000. This despite climate change, despite wolves. Despite everything.

For many scientists and hunters, this felt like hope. It wasn't clear why the Porcupine were thriving while other herds declined all around them; as with everything caribou, the answer was likely hidden in the intricate weave of climate, biology, and landscape. But briefly it looked as though the Porcupine might hold a secret, some clue that could help illuminate, or maybe slow, the vanishing.

Lean on an outlier, though, and it often begins to shift. Heather Johnson, the USGS researcher, recently cautioned me not to make too much of the Porcupine's numbers. The herd hadn't been accurately counted for six years, she said, and in the meantime, hunters have observed worrisome trends in body condition: The caribou are increasingly in poor shape, packing less of the crucial fat that helps them survive brutal Arctic winters. "The idea that they're not declining is kind of out of date," Johnson said. "We really don't know."

Around the time this article went to press, in fall 2023, some people I spoke with were anticipating the release of new caribou surveys, which are usually done over the summer. The Western and Porcupine were both due for fresh counts, and an increase in either could boost the mood, even affect hunting regulations. On the other hand, bad numbers would only deepen the gloom.

Kyle Joly, the National Park Service biologist, told me it had already been a tough year for the Western. He'd spent part of July in northern DURING THE TIME I SPENT WITH JUDAS AND HIS

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It wasn't clear why the Porcupine herd was thriving while other herds declined.

Alaska recovering satellite tracking collars from caribou that had died during a brutal winter that saw deep, wet snow-cement-like stuff that's hard for caribou to travel through. In September brighter news unfolded on the state's oil-rich North Slope where the Department of the Interior canceled all petroleum leases in the immense Arctic National Wildlife Refuge, home to the Porcupine's calving grounds.

The news was celebrated among the Gwich'in, for whom the area around the calving grounds is holy, "the sacred place where life begins," But human hunger for oil still looms over the Porcupine's future. While there's no drilling in the refuge now, there's also no guarantee a new administration, or a new Congress, won't push for it. Local and national politicians have already tried and failed dozens of times.

"I think it's been hard for us to quantify how much has been changing for caribou," Johnson told me. But "if there's one thing they don't like, it's industrial development. They are just really sensitive to development. It's been shown so many times."

In a mystery the size of a continent, she said, this may be the best lead we have.

CARIBOU ARE CREATURES OF HABIT, AND THEIR

habits seem synced to an older and colder world that no longer exists. The question in our time is how quickly they will or won't adapt. Late one October I stood alone on the shore of the Kobuk River in western Alaska, watching a young male try to swim the black water. He struggled. Large rafts of ice tumbled down the current, battering him, shoving him under. A group of his less daring companions stood on the shore waiting to see how things would turn out.

The place was Onion Portage, and for 10,000 years caribou had been coming here to cross the river at the end of their autumn migration. Artifacts show that for at least that long humans had been arriving to meet them, hunt them, process their flesh and hides and bones. It was a regular appointment, kept across millennia. And though local hunters still showed up, the caribou now were often late or didn't come at all.

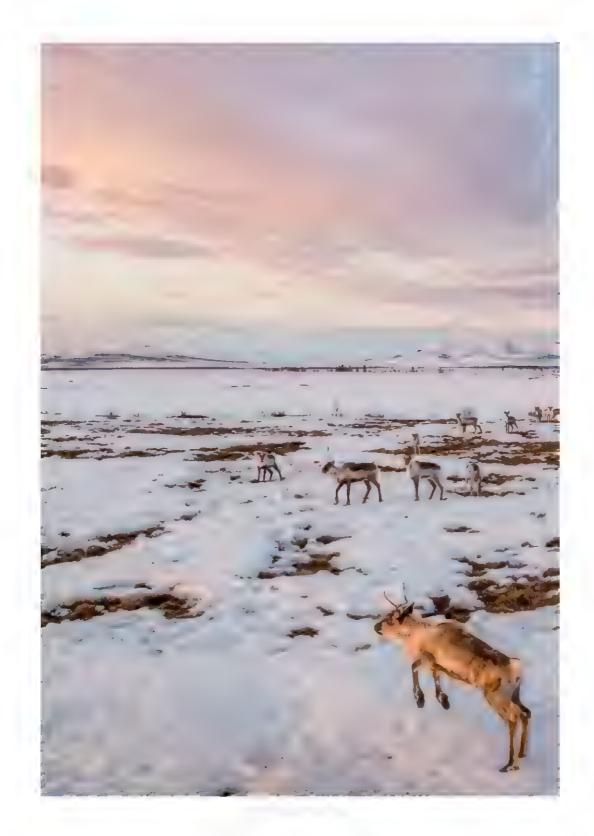
The shifting migration brought consequences for both humans and animals. In the caribou's case, arriving later in the season meant finding a river in flux-not exactly liquid, not fully frozen. Crossing was dangerous, as the young male was learning. Waiting for freeze-up was too: Wolves and bears patrolled the forest along the riverbank. But the caribou had no choice. For days hundreds of them paced up and down the river, yards from my tent, filling the air with their musky scent and the peculiar click click click that comes as they walk, a sound thought to be made by tendons snapping over bones in their feet. They were restless and wanted only to continue their journey.

From my small vantage it seemed impossible the world would ever return to the way it had been when this route over the river, this habit of movement, was laid down in their ancestors' minds. Already the portage itself was being transformed by new trees and shrubs that had crowded in and grown tall as the climate warmed. But I'd been told by many Indigenous people that the caribou would adjust, given time. They were curious, resilient. In the Arctic they had to be.

I looked back to the river: a chunk of ice, a blow to the head, another dunking. The young male surfaced in a spluttering fit. He decided to turn around. At the shore he shook wildly, rejoined the others. The herd turned to regard me-gray bodies, big racks, eyes wide. Then the caribou stepped up the bank and disappeared into the trees.

□

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INSTAGRAM

BEVERLY JOUBERT

FROM OUR PHOTOGRAPHERS

WHO

A conservation filmmaker and photographer specializing in African wildlife where

Southeastern Kenya

WHAT

Sony Alpha 1 camera with a 600mm lens

A National Geographic Explorer at Large, Joubert was filming giraffes in Kenya's Chyulu Hills for an upcoming documentary. To get close without spooking the animals, she spent days in an underground blind near a watering hole. Giraffes came and went, but red-billed oxpeckers routinely stole the show. Swooping from one giraffe to the next, the industrious birds picked off ticks and other parasites, cleaned stray food from teeth, and plucked loose hairs for use in their nests. "Everywhere you look in the natural world," Joubert says, "there are fascinating examples of adaptation and interdependence."

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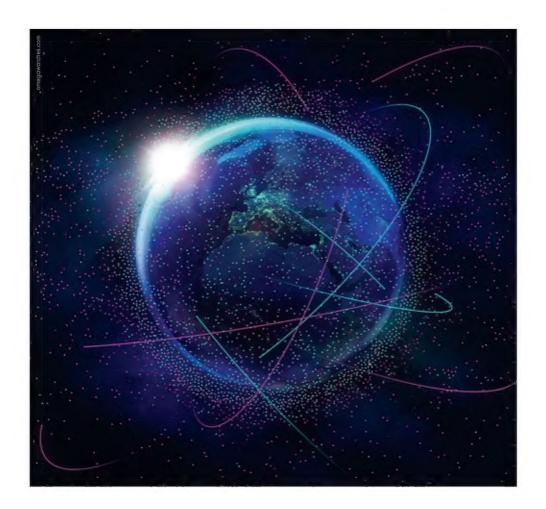
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PURINA TIDY



A MAP TO THE FUTURE



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